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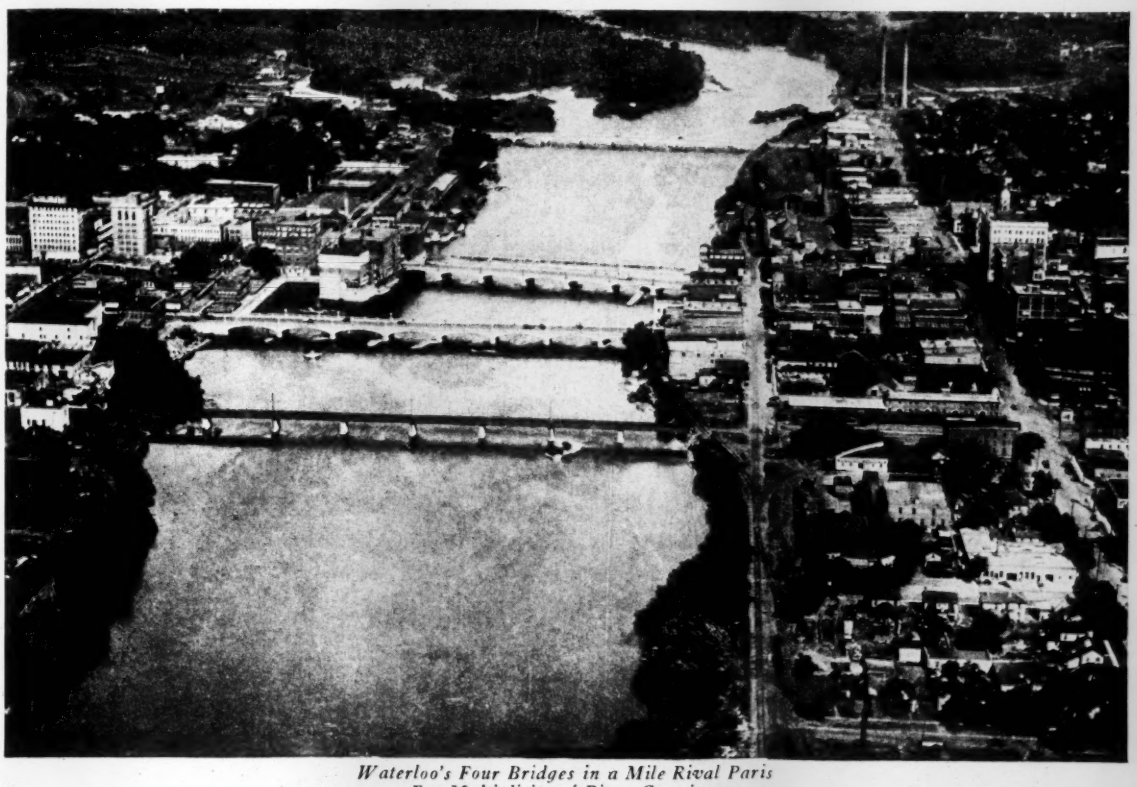
Engineering News-Record



Waterloo's Four Bridges in a Mile Rival Paris For Multiplicity of River Crossings

The Editor Visits the City Engineer: Waterloo, Iowa

Batten Plate Columns: Their Status and a Design Theory—Eleven Dams Make Storage Reservoir of Lake Kenogami—Progress of Sewage Disposal Program at Chicago-II; North Side Plant—How to Prevent and Restore Frozen Concrete

KREOLITE

Bridge Spanning Cuyahoga River, Cleveland, Ohio

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 96 NEW YORK, MARCH 11, 1926 Number 10

Squeezing Out the Water

THERE is a generally expressed opinion, on the street and in the newspapers and even by government leaders at Washington, that the big slump in stocks last week was only a Wall Street flurry and that its effect on industrial conditions will be negligible. The validity of this remains to be seen. Basic conditions in the country are today quite as satisfactory as they were at the beginning of the year. There is in sight no crisis in industrial, agricultural or financial affairs that would presage early difficulties. Optimism is therefore justified. But the slump in stocks is ominous to this degree; it is the expected sign of the beginning of the end of the speculative craze that has been spreading and expanding for a year or more and that has manifested itself not only in stocks but in real estate and in buildings. This speculation has been obviously unsound. As in all speculation the individual expected to profit by it only as he could guess its end and when that end comes the few who are good guessers are vastly outnumbered by the many who are still hanging on. Last week the bottom dropped out of the stock boom. For some time it has been evident that Florida's expected deflation was well along on its way. A general let up in speculative building may be expected to follow. All of these are not dangerous to public welfare—unless they get out of hand and the stung speculator in his effort to prop up his own collapsing structure begins to pull down about him the necessary columns of the neighboring stable buildings. So far this progressive destruction has not set in. Strong hands are holding up Wall Street. Florida can well stand a little squeezing and there can be such a thing as too much building. The question now is, then, not how far but how fast. The next few weeks will show. If the decline is gradual, no danger lies ahead, for the result will be a saner devotion to normal productive effort and less emotional interest in unjustified boosting of stock quotations.

Winter Costs

AN eminently sane estimate of winter construction as it is experienced outside of large buildings and other operations where shelter can be provided is given in the article in this issue on dam construction in Quebec. Writing as a contractor the author of the article points out emphatically that construction costs more when handicapped by frost and storm. The fact that this extra cost was warranted in order that the Quebec authorities might meet their commitments to furnish power is not permitted to confuse the issue. This is worth observing. Not all writers and speakers of the multitude who discuss seasonal employment and winter work are keeping clear the distinction between economy and cost. It is therefore particularly the obligation of the constructor to do so. One may concede all that the Hoover committee report on seasonal construction has to present and everything that a dozen building congresses have published and yet keep it clear that more units of work are required in winter than in summer to produce a unit of structure. It has been perhaps a little disadvantageous to this clear thinking that most of the available statistics of winter construction costs are derived from large building operations where the imposts of cold and storm are almost the least and the profits of speedy completion and cheaper labor are the greatest. The conditions are quite different in operations such as the Quebec dams described on another page. Indeed we need to be chary in generalizing concerning winter construction. It has in instances its drawbacks, and in presenting these the article on the Quebec dams deserves commendation.

Forced Settlement of Fills

FORCED settlement of highway fills to hasten the time when it is safe to lay pavement on new grade is an enticing thought to road builders. As practiced in Illinois occasionally for two seasons settlement by water jet seems quite positive and not excessively expensive. The same method, as used in Missouri the last season, also gave positive settlement. Indeed there should be no question of this accomplishment as the method has been used in earth dam construction with complete success in consolidation. The drawback to jetting or indeed to any method of water consolidation is the slow drying out of many soils of the gumbo, clayey-loam or other alluvial types. These soils, though completely settled, keep wet enough for a little time to rut and slough badly under the loads on subgrade of modern road building equipment. The solution, as is pointed out on another page, is to keep the water consolidation a fortnight or three weeks ahead of the paving schedule. This done there is distinct usefulness in forced settlement by water jets.

Staggered Office Hours

IN THE crisis of war a number of things can be done by fiat that are obviously necessary and desirable but which in the more democratic days of peace seem impossible to accomplish. One such instance was the staggering of office hours in our crowded centers. No more senseless or inefficient practice could be devised than the coincidence of office hours in business districts of our cities. It is an oft-quoted remark that were all the occupants of the skyscrapers in any crowded city to emerge at once the streets would be several bodies deep, so that it can be seen that this coincidence does not bring about absolute unanimity of movement, but to have every adjacent office opening officially at 9 and closing at 5 does bring controlling peaks in street traffic and in transit facilities. During the war in several of

our cities it was possible by municipal order to stagger office hours and perceptibly to reduce this congestion. Now, however, the inertia of the individual and the lack of authority to overcome individual objectors has made so sensible an arrangement impossible. In New York certain interests are trying to work out a stagger-hour scheme. By hearings and meetings the benefits of the proposal are being given publicity and some of the city departments are trying to work out a schedule of hours by districts which will give an optimum advantage. The plan will not eliminate congestion but, without harming anyone, it will benefit conditions to some degree. All it needs is agreement of many interests—which prompts the pessimistic reflection that that alone will probably defeat it.

Essentials of a City Engineer

EIGHT qualifications and a rule of conduct for success as a city engineer are laid down in a short abstract of a paper by a successful city engineer elsewhere in this issue. The qualifications are honesty, tact, engineering knowledge, good address, courage, poise, mixability and sobriety. Sobriety might be put with keeping out of politics as a rule of conduct, and honesty either similarly classed or else disposed of as a trait or an element of character essential in any profession or other honorable calling. The qualifications would then be reduced to six. Whether tact, good address, courage, poise and mixability are any more essential to a city engineer than to any other administrative office, public or private, might be argued pro and con, but undeniably a city engineer needs all in large degree. Engineering knowledge—presumably intended to cover engineering experience, wisdom and judgment as well—almost goes without saying, but could hardly be omitted; especially not all those who appoint city engineers realize its importance. One thing seems to have left out, unless it is supposed to be a compound of some of the qualifications named, and that is administrative ability.

"Practical Research"

AT A recent technical meeting one of the leading railroad engineers of the Middle West undertook to rebuke the society which he addressed and by connotation all other scientific and technical societies for their adherence to what he was pleased to call "theoretical research." He and his railroad colleagues, he said, were up against practical problems the greatest of which was how to finance their undertakings. They gained nothing from the researches that the technical world conducted; what they wanted to have light on was how to get money enough for the railroads. He wanted to see some sort of "practical research," which would solve this critical problem. One can readily sympathize with such an attitude on the part of a railroad engineer. It is only too true that the engineering development of the railroads has been retarded by lack of railroad money, a lack which has borne down harder on the engineering departments than on any other, because engineering improvements are as a rule capital additions and the appropriating authorities, who want immediate returns, know that their effect on revenue is distributed or deferred. No wonder that sometimes the railroad engineer becomes irritated at the man who tells him how he can design more efficiently or build more cheaply, when he cannot get money to design or build at all. But granting that, there is a well founded suspicion that the state of mind that this particular engineer revealed is one of the reasons why other engineers are sometimes critical of their railroad brethren. One of the very papers criticized by this engineer contained a guarded reference to a bridge where the man who had followed some of the derided "theoretical research" had redesigned a structure of a "practical" railroad man at a saving of some tens of thousands of dollars. There are two ways to get money; one may make more or one may save more. If our "practical" railroad engineers can learn from "theoretical research" how to save money it will conceivably benefit the railroads as much as would some "practical research" which would teach them how to get more money with which to continue to build the "practical" structure they desire.

High Credit Rating

AN unusual event even in these days of unusual financial developments is the sale of fourteen millions worth of bridge bonds by the Port of New York Authority last week. The sale shows that toll bridges have a surprisingly high credit rating. This faith in toll bridge and traffic possibilities is wholly the growth of the last few years. In sharp contrast with the difficulty of financing the Bear Mountain bridge less than four years ago, we find as the outstanding feature of the present sale, in which first-class financial houses were the buyers, the fact that price and interest rate are extraordinarily liberal for a speculative undertaking, being about such as would apply to good municipal bonds. The Port Authority bonds are to be used for building two bridges between Staten Island (in New York) and New Jersey. They are secured only by the tolls to be collected on these bridges, but are not backed by the property itself, nor by public credit, so that they are similar to stock or "income bonds" and are decidedly less substantial than the bonds of a private corporation, which would rest on a mortgage covering the property. Further, the Port Authority enterprise is at a disadvantage because of the excessive cost of work built by public commissions, of which the Passaic Valley sewer, the Holland tunnel and the Philadelphia bridge furnish recent examples. Yet financiers evidently feel so well assured of the earnings of the bridges that they accept them as equal in security to a property mortgage or a pledging of public credit. It may be that they count also on the possibility that any shortcomings would be made good by the two states, even though the latter are not obligated to do so. In any event the sale shows that toll bridges are now in distinct favor. Conclusion of a final toll agreement by Pennsylvania and New Jersey on the Philadelphia bridge, also reached last week, gives further support to an optimistic attitude toward the subject. This constructive development should prove favorable to other necessary bridge enterprises. The situation will become even better when it is made a rule of practice that toll collection shall always be limited to the amortization period, as has been decided for the Philadelphia bridge. New York has already diverted part of its tunnel tolls from their original amortization purpose. The temptation to use toll income for revenue is an ever-present danger.

For Saner Rail Financing

THE Interstate Commerce Commission has disapproved the Nickel Plate merger plan on the grounds that the financial side of the plan is not just and reasonable. In thus making clear that it will not be a rubber stamp for the approval of any railroad consolidation plan presented to it, no matter how desirable some features of the plan might be, the commission has rendered a notable service. In the past there has been too much of just such voting away of control of railroad companies by directors who appear to be more interested in the possibilities of the acquiring company—of which they also were directors—than in the rights and interests of the stockholders of the selling company whom they professed to represent. Great fortunes were made in the past by these methods—and many small ones were lost—and the railroads fell into a disrepute from which even now they still suffer.

If a return to such methods is necessary in order to have railroad consolidation then the country is better off without it. That a return is not necessary is indicated by the better terms offered the stockholders of the Erie and Pere Marquette in this merger plan—railroad companies whose boards of directors did not contain a majority of men who also were directors of the Nickel Plate—and the terms offered the stockholders of the Chesapeake & Ohio and Hocking Valley Railroads whose boards did contain such a majority; this, despite the fact that the two latter roads have greater earning capacity.

The commission also issues a further warning against non-voting stock, a warning that has been sounded so frequently of late that financiers should take note that the country is beginning to fear this form of irresponsible control and will have none of it. The commission points out that in this case the Van Sweringens, who now control only 32.85 per cent of the voting stock of the companies affected by the proposed merger, will, without purchasing a single share, control 50.93 per cent of the *voting* stock of the new company through the issue of non-voting stock in exchange for voting stock.

From a transportation standpoint the commission finds the proposed merger satisfactory. The estimated saving in annual operating costs is put at $6,000,000 and there seems to be no destruction of effective competition. In fact there will be more effective competition with larger systems of the East, the New York Central, the Pennsylvania and the Baltimore & Ohio. In view of these facts the commission records its approval of the merger plans. It remains, therefore, for the Van Sweringen interests to modify the plan only in its financial aspects. That this can and will be done seems quite probable.

The decision is far from being a serious blow to railroad consolidation. Rather it clears the air. If railroad consolidation is desirable as an economic proposition it is likely to gain impetus by this frank statement by the Interstate Commerce Commission that it approves the Nickel Plate plan except for its financial features even though the plan does not agree with the commission's tentative consolidation plan. On the other hand, if the consolidation plans which now are pending are simply for the financial benefit of a few financiers then this decision will have the desired effect of putting a stop to them.

New York State Department Consolidation

NEW YORK STATE will net the greatest gain in the adoption of the reorganization plan just recommended in the reduction of departments and the better co-ordination of the administrative work of those that are left. There will be only four elective offices under the new plan: Governor, lieutenant-governor, attorney general, and comptroller. Happily, the state engineer and surveyor becomes one of the appointive officers.

Consolidation of all of the engineering, architectural, and construction work of the state into a single department will be a great gain for efficiency and economy and be of no little benefit to engineers, contractors, manufacturers and supplymen who have intimate contact with the state and now have to deal with many departments and bureaus and minor officials, often working more or less at cross purposes. An earlier proposal of members of the Legislature to establish a separate department of architecture while putting the engineering work of the state in a bureau subordinate to the commissioner of public works is set aside. Instead, there will be in effect a bureau of engineering and a bureau of architecture of co-ordinate rank.

Some may be disappointed because the plan does not specify that the commissioner of public works shall be an engineer or at least a man of large experience in construction work. As to that it should be remembered that the department heads are in a sense like federal cabinet officers and that many factors enter into their selection by a governor. Yet the plan does set up qualifications, and rather exacting ones, for the commissioner of health. That official must be a "physician, a graduate of an incorporated medical college, of at least ten years' experience in the actual practice of his profession and of skill and experience in public health duties and sanitary science." Of this requirement it may be said that the work of the commissioner of public health is more specific in character than that of the commissioner of public works, but even if this be granted it does not follow that it is necessary for efficient health administration in New York State to require each succeeding governor to pick out a doctor of medicine for the work instead of letting him consider first of all the possible qualifications of men of broad training and experience in public health administration who have never taken a medical course. As matters stand, training or experience in public hygiene is all that is specified as a qualification for the office.

The specifications for state engineer are neither elaborate nor definite, the provision being that the state engineer shall be a "practical civil engineer." Why any qualification whatever for the state engineer should be included in the plan and none for the state architect is an interesting subject for speculation, but perhaps no more so than why the plan should not provide that the attorney general should be an attorney. The fact seems to be that it is taken for granted that no one but a lawyer would be appointed as attorney general and that no one but an architect would be appointed as state architect, but that there is still some doubt even among such experienced and intelligent men as the chairman and other ex-governors on the commission as to whether some governor would not fail to appoint an engineer as state engineer or even if he did pick out an engineer might overlook the necessity of having a "practical" man for the position.

Progress of the Sewage Disposal Program at Chicago—II

Design and Early Construction Methods of North Side Activated-Sludge Plant for 800,000 Population—Cableways Handle Concrete and Equipment — Bulk Cement Shipped in Refrigerator Cars

By Edward J. Kelly
Chief Engineer, Sanitary District of Chicago

This article describes the North Side sewage disposal plant only. The present status of the six major sewage projects of the Chicago Sanitary District was outlined in Article I, March 4, p. 363.—Editor.

A DESCRIPTION of the main features of the North Side treatment project will be of interest since considerable progress has now been made on the construction of some of the main plant units. Special requirements have been worked out in detail as the schedule calls for completion of the project in 1928.

By 1930 it is expected that sewage from a tributary population of 800,000 will be treated, and the plant capacity will be sufficient to handle 50 per cent in excess of the average flow. Future increase is provided for throughout.

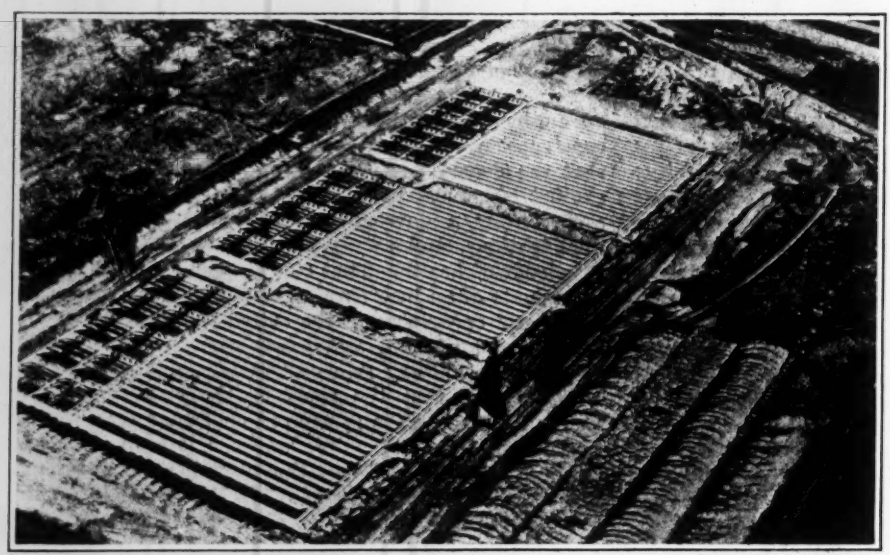

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FIG. 1—NORTH SIDE ACTIVATED-SLUDGE PLANT, CHICAGO SANITARY DISTRICT

The treatment works are being built on 100 acres of land, Figs. 1 and 2, lying west of the North Shore Channel and north of Howard St., in the village of Niles Center, just north of the Chicago city limits. This property is divided by the Mayfair cutoff of the Chicago & Northwestern Railway Co. West of the tracks will lie the treatment works proper, including grit chambers, preliminary settling tanks, aeration and settling tank units, the main building, sludge pumping station and the service building. The sewage pump and blower house will lie east of the railroad tracks.

Three batteries of tanks will be provided, Fig. 3, each battery consisting of twelve circulating-type aeration tanks, ten settling tanks and an operating gallery. Each aeration tank is 34 ft. 9 in. c. to c. of walls laterally and 420 ft. long, and is divided into two equal compartments by a central wall. The aeration plates will be located on one side of the bottom of each compartment to give a circulating movement to the sewage. The settling tanks, Fig. 4, are 77 ft. square and are equipped with Dorr clarifiers, Fig. 4. All meters and equipment for regulating the flow of sewage, air and sludge will be installed in the operating galleries.

The grit chambers and coarse bar screens will be housed in a separate structure. The twelve grit chambers are 80 ft. long and 8 ft. wide with a water depth of 4 to 6½ ft. These will be cleaned by a ¾-yd. bucket operated from an overhead telpher system. An electrically operated elevator and scrubber will be installed for washing the sand. Sewage from the grit chamber will pass through four coarse bar screens 15 ft. wide with 1-in. clear openings. Screenings will be removed by an ejector to the incinerator. Preliminary settling tanks following the screens will consist of eight tanks 80 ft. square, averaging 9 ft. in depth, having a detention period of 30 min. at the average 1930 flow.

North Side Sewers—The collecting system consists of 13.8 miles of sewer including 3.5 miles of 15-ft. sewers. About 40 per cent of the entire North Side project cost, or $11,000,000, will go into the sewerage system. Sewers finished or under contract now amount to $10,400,000 in cost. This intercepting system is designed as a sanitary sewerage system only, but will carry up to 50 per cent in excess of the dry-weather flow as of 1960.

Much of the city sewerage system lies considerably above these interceptors. Where this condition is pronounced, the "hydraulic jump" has been utilized to dissipate the acquired kinetic energy of the falling water passing the sewage control devices so as to avoid cutting down the capacity of the interceptors. Practically the entire intercepting system is being built in tunnel, in part on account of its great depth, and in part to avoid interference with traffic and utilities in congested streets.

Buildings—Three principal buildings will house equipment and other facilities. One of the largest units is the pump and blower building to house the sewage pumping equipment and the electrical and mechanical units which will supply air for the entire plant.

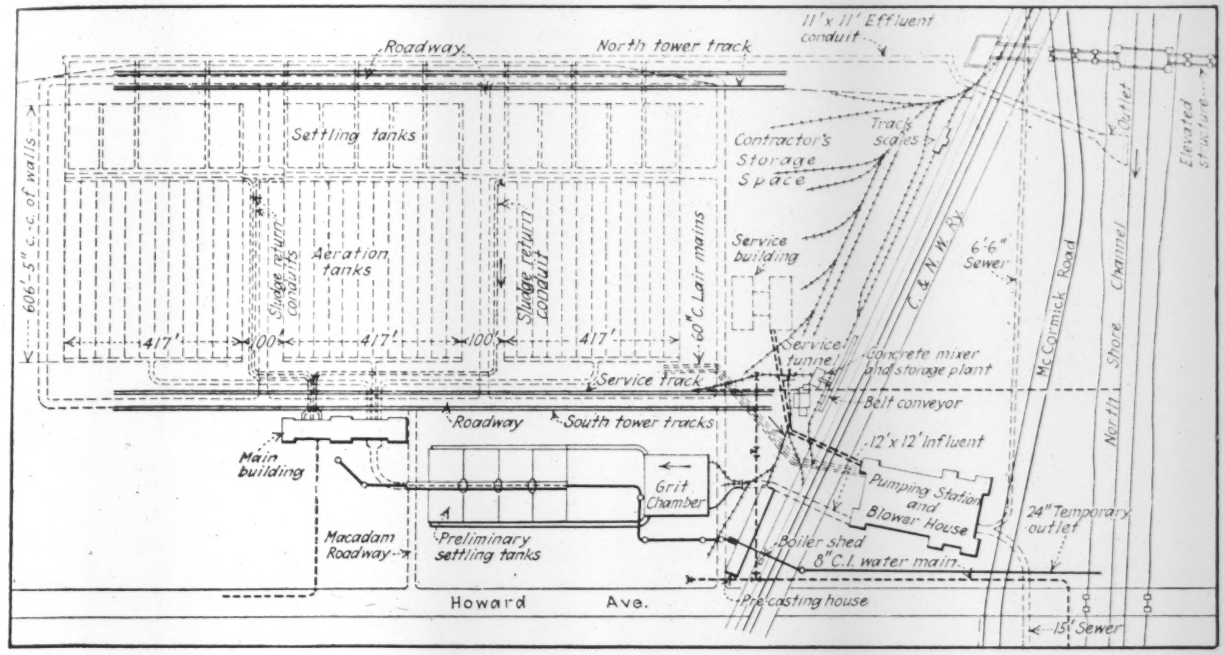


FIG. 2—NORTH SIDE SEWAGE TREATMENT WORKS, WITH CONTRACTOR'S PLANT LAYOUT

The architectural style is Gothic. The ground area is about 303 ft. long and varies from 166 ft. to 183 ft. in width. The walls will be carried on a structural steel frame.

There will be in general four levels. The large pumps will be at El. —4.15, Chicago city datum. The blowers will be placed at the +25 level. This level will be served by a 34-ton electrically operated crane having a span between crane rails of 70 ft. 11 in. and a travel between crane stops of about 200 ft. At the east end of the building, El. +40, will be the switchboard balcony. Part of this level will be reserved also for the air conditioning system and for storage space. El. +57 will house a portion of the air conditioning

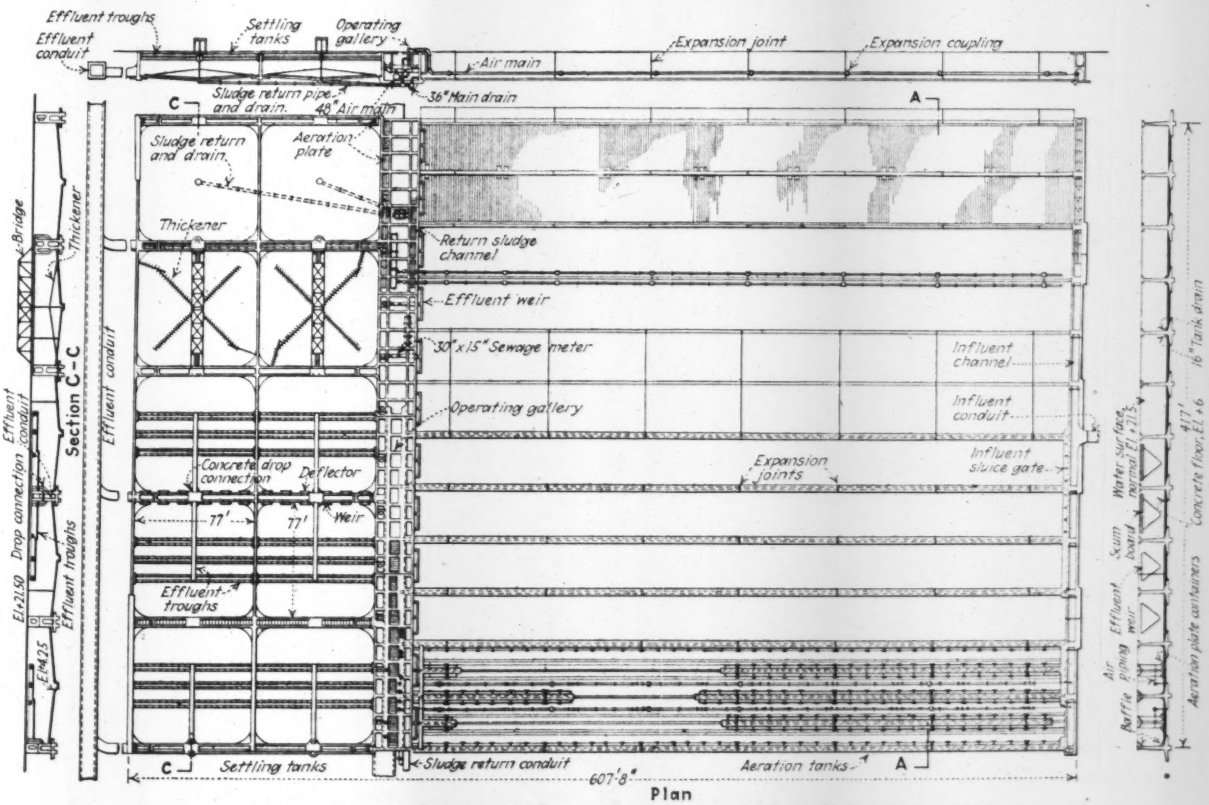


FIG. 3—ONE OF THREE BATTERIES OF AERATORS AND SETTLING TANKS

system, storage space being reserved in addition for oil and for mechanical parts and equipment. A 15-ton electrically operated monorail hoist will be supported from the floor level at +57 to serve the transformer room which will be located below at El. +21.

One passenger elevator of 2,500-lb. live-load capacity, one 6-ton freight elevator and one oil elevator at 1,000 lb. will be installed. An auxiliary crane of 15-ton capacity on a span of 28 ft. 10½ in. in the southwest tower will be used for operating the stop logs in the sewage conduit leading to the pumps.

Mechanical and Electrical Equipment—The blower units will consist of four turbo-type blowers, each having a capacity of 40,000 cu.ft. of free air per minute, and three similar blowers each of 30,000-cu.ft. capacity. The larger units will each be directly connected to a 2,160-hp. motor, the smaller blower units each to a 1,650-hp. motor, all blowers to operate against a pressure of 7.75 lb. per square inch.

A battery of five sewage pumps will be installed in the pump and blower building. Two pumps, each driven by a 1,000-hp. motor, will have a capacity of 150 sec.-ft. each, under a 44-ft. total dynamic head, with 48-in. suction and discharge openings. Three pumps, each driven by a 700-hp. motor, will have a capacity of 100 sec.-ft. each, under a 44-ft. total dynamic head with suction opening of 48 in. and discharge opening of 42 in. The sewage pumps are designed so that their capacity may be increased 20 per cent by changing the impellers, and provision is made for an additional unit in 1955. Water for air conditioning will be pumped by four units, each having a rated capacity of 2,250 gal. per minute against a total dynamic head of 155 feet.

Operating conditions, such as air pressure and temperature, will be shown by instruments centralized in a room adjacent to the office of the chief operating engineer where complete operating data will be automatically recorded, including measurements of quantities, and the entire plant operation will be regulated from this information. This will constitute one of the most comprehensive automatic instrument control systems ever installed in a plant of this or a similar nature.

Electric power will be supplied by 6,600-volt and 12,000-volt feeders. Transformer banks will be in duplicate, one bank being for reserve. Electric or mechanical interlocking has been resorted to throughout the design of the equipment so far as practicable, to reduce the number of mechanical operations and for protection purposes. For example, all disconnecting switches will be gang-operated and interlocked with the oil switches to eliminate the possibility of operating disconnecting switches under load. All mail motors and oil switches will be electrically operated by remote control. Special control features will insure proper starting sequence for pump blower motors and will interlock the starting equipment.

The switchboard balcony in the pump and blower building is located so as to permit the operator an unobstructed view of the blower floor. This will require a glass partition between the switchboard balcony and the blower room so as to minimize the volume of operating machinery noise which will find its way to the

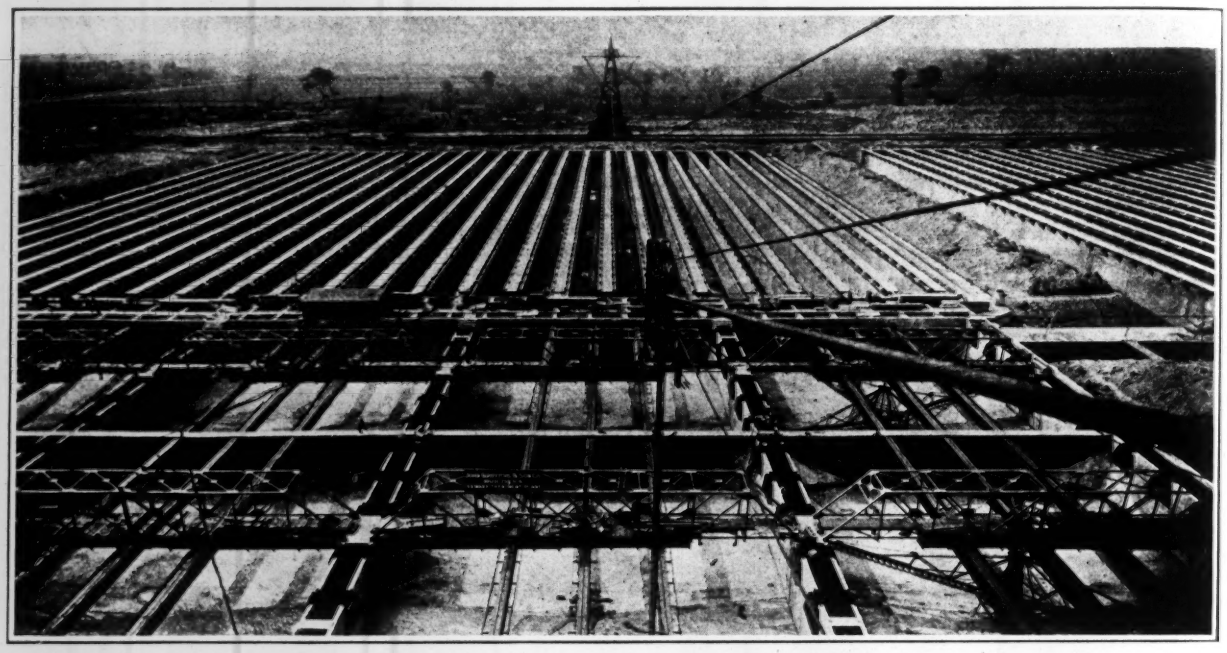


FIG. 4—THIRTY DORR CLARIFIERS IN 77-FT. SETTLING TANKS REMOVE SLUDGE AERATED IN 420-FT. AERATION TANKS
Picture taken from construction cableway spanning both aerators and settling tanks. Flows on sweeping arms have extension arrangements to cover corners of square area of floor.

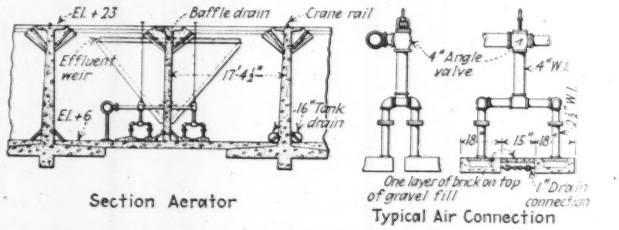


FIG. 5—SECTION OF AERATOR AND TYPICAL AIR CONNECTION TO FILTROS PLATE

switchboard balcony. Electrical control instruments will be mounted on a 44-panel convex bench board consisting of a bench and vertical meter panels. A conservatory type of roof over the switchboard balcony will permit daylight operating conditions throughout the entire daylight period. Night lighting will be supplied by high-power lamps mounted on the steel framework supporting the glass roof.

Other Buildings—The Main Building will house general offices, laboratories, storage and necessary facilities to take care of the plant operating forces. In addition, this building will contain the three 7-ft. x 5-ft. 4.3-in. where it will be pumped to the influent conduit of each battery of tanks. The waste sludge and the preliminary settling tank sludge will be pumped away from the plant site for disposal. The effluent from the plant will pass into the North Shore Channel nearby.

Basic design assumptions are as follows:

Tributary population as of 1930	800,000
Average daily sewage flow per capita	219 gal.
Detention period in preliminary settling tanks	0.5 hour
Contact period in aeration tanks	6 hours
Depth of sewage over diffusers	15 ft.
Returned sludge in mixture	20 per cent
Air used per gallon of sewage	0.75 cu.ft.
Maximum rate of sedimentation tanks	1,600 gal. per sq.ft. per day
Depth of sewage in sedimentation tanks	16 ft.

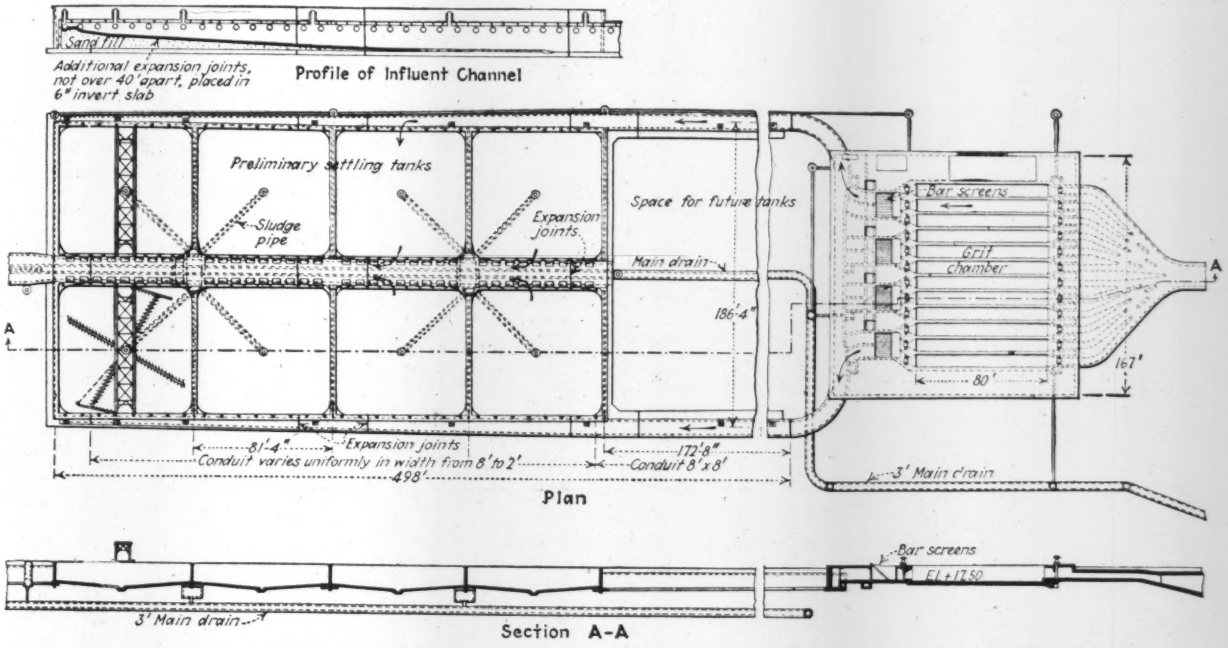


FIG. 6—GRIT CHAMBERS AND PRELIMINARY SETTLING TANKS WITH CLARIFIER MECHANISM

master sewage venturi meters for measuring the entire flow through the plant; also four sludge return pumps designed for a rated capacity of 8,000 gal. per minute against a 7-ft. head and two waste sludge pumps with a rated capacity of 1,000 gal. per minute against a total dynamic head of 180 ft. The waste sludge pumps will deliver the sludge to the point where it will be digested and finally dried. This may be done at the West Side treatment plant.

The Service Building will contain a central heating plant, incinerator plant, machine shop, pipe shop, carpenter shop and some storage space.

The general ground level of the entire treatment plant site is to be uniformly raised approximately 5 ft., leveled off and eventually sodded and landscaped. Ample service tracks leading from the C. & N. W. right-of-way will be provided as well as drives leading to the new McCormick Road just east of the treatment plant site.

Operating Cycle—Sewage coming into the North Side plant will be delivered by pumping units to the grit chamber where the sand will be removed, will pass through coarse bar screens into the preliminary settling tanks where a portion of the suspended matter will be settled out; then through the three venturi meters in the main building to the aeration tanks, and from there to the final settling tanks. Sludge from the settling tanks will be returned by gravity to the main building

Construction Progress—Construction work has progressed rapidly since the letting of the first contract (Division A) on Aug. 9, 1923, in the amount of $5,602,636. This contract covers the aeration and settling

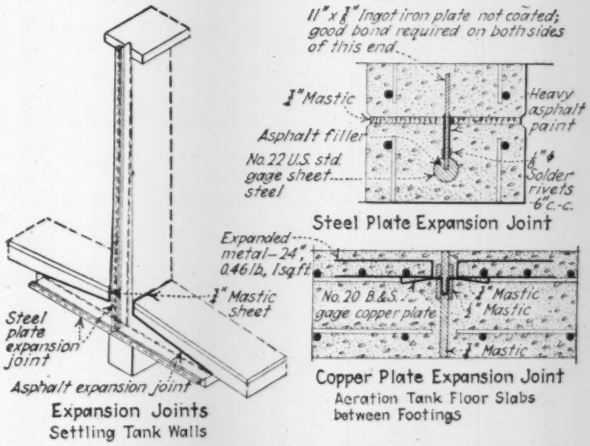

11" x ⅜" Ingot iron plate not coated; good bond required on both sides of this end
½" Mastic
Heavy asphalt paint
Asphalt filler
No. 22 U.S. std. gage sheet steel
¾" ϕ Solder rivets 6" c.-c.
Steel Plate Expansion Joint
Expanded metal—24" 0.46 lb. I sq.ft.
No. 20 B.&S. gage copper plate
½" Mastic
½" Mastic
½" Mastic
½" Mastic
Copper Plate Expansion Joint
Aeration Tank Floor Slabs between Footings
Steel plate expansion joint
Asphalt expansion joint
Expansion Joints
Settling Tank Walls

FIG. 7—TYPICAL EXPANSION JOINTS FOR WALLS AND FLOORS OF AERATION AND SETTLING TANKS

tanks, operating gallery, influent and effluent conduits and piping. It was completed in December, 1925, about one year ahead of schedule. Additional contracts for

furnishing Dorr clarifiers, air and sewage meters, sluice gates, filtros plates, blowers and pumps and electrical equipment, aggregating a cost of $900,860 (divisions B, C, D, E, H and I), have been let. More than 70 per cent of the $27,433,000 North Side project is now under contract.

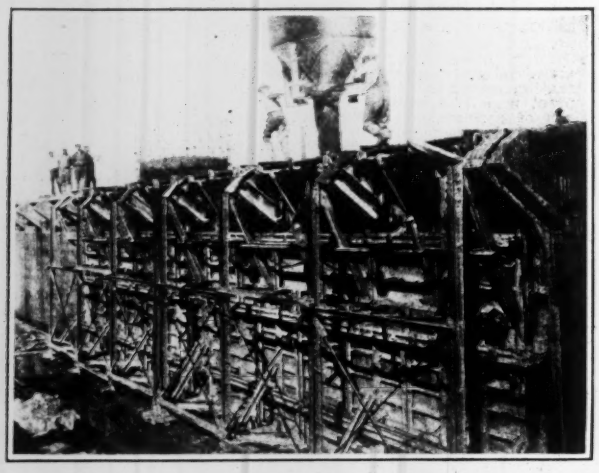


FIG. 8—POURING CONCRETE FROM 5-YD. BUCKET INTO STEEL FORMS FOR AERATION WALLS
Deflector carriers at the top of the wall made complicated formwork which was cared for by steel struts to the floor.

Construction of the preliminary settling tanks and grit chambers (division K) has been contracted for and started. Also the operating gallery superstructure contract (division J) has been let. Contract prices for all of this work amount to $1,117,756. Contract divisions L to O, inclusive, covering centrifugal pumps, air conditioning equipment, elevators and gang-operated disconnect switches for the pump and blower building, have also been awarded. The contract for the construction of the pump and blower building and the mechanical and electrical equipment to be housed therein (division P) amounting to $3,791,000 was let Nov. 19, 1925. Plans and specifications for miscellaneous sewage, water, air, steam and service conduits and for the main building, the service building and the superstructure for the grit chambers and equipment therein, are in preparation and should be advertised for bids early this year. In addition, there will be a contract for the sludge force main to the disposal area west of the city, and a final contract for landscaping the area surrounding the disposal works.

An idea of the size of this plant may be gained by considering the following major quantities involved in the first contract, which comprises only about 20 per cent of the cost of the entire project for the North Side treatment works:

Excavation	452,500 cu.yd.
Concrete (of various classes)	117,600 cu.yd.
Reinforcing steel	6,059 tons
Reinforcing mesh	214 tons
Cast-iron pipe (carrying from 6 in. to 60 in.)	2,818 tons
Structural steel	875 tons

Excavation—As the area around the structures and south to Howard St. is to be filled to a depth of 5 ft. above the original surface, the top soil was stripped from the entire area and stored, it will be replaced after the grading is finished. Grading was done by an elevating grader drawn by a caterpillar and the excavated material hauled to storage piles by teams. Stripping was delayed by heavy rains and early frost but was kept ahead of the bulk excavation. Some 65,000 cu.yd. of earth was handled.

Excavation for the tanks was started at the east battery simultaneously with trenching for the conduits. The heaviest work was handled by steam shovels while two small draglines did the lighter work and trenching. Excavation for the batteries was carried at one cut to El. 3.5 under the aeration tanks and El. 5.2 under the settling tanks. The trench for the operating gallery was cut to El. 0.50. The ground surface, after stripping the top soil, was approximately El. 16, making an average cut of 12.5 ft. Below the top soil is a loamy yellow clay to a depth of 4 to 5 ft. shading into a blue clay of varying stiffness. In general, a good foundation was found at footing elevation, except for several pockets of soft material which had to be cleaned out. Trenching for footing cutoff walls was done by hand. The flat conical bottoms of the settling tanks, roughly shaped by dragline, were trimmed by hand. Grading between the C. & N. W. tracks and the east battery provided room for a storage yard and 100-ft. strips north and south of the batteries for the cableway tower tracks (described later). The remainder of the spoil was

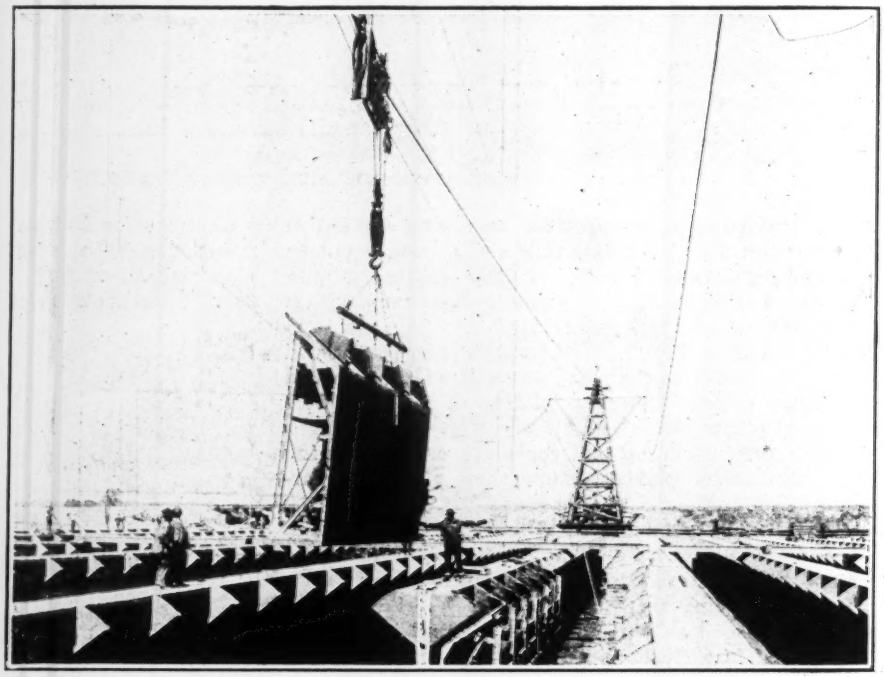


FIG. 9—CABLEWAY TRANSFERRING AERATOR WALL FORM
Note blocking under struts removed to tilt form away from top of wall.

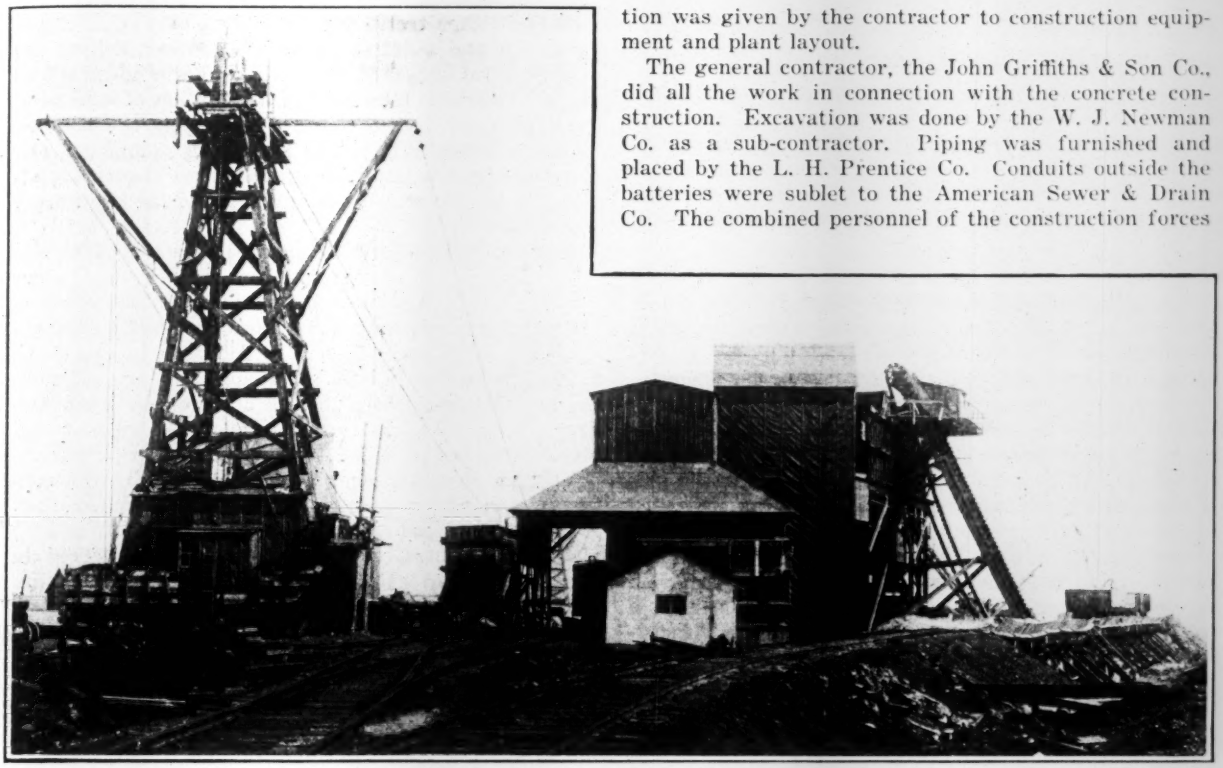


FIG. 10—CABLEWAY TOWER AND CONCRETE MIXING PLANT

stored west and south of the batteries, leaving a space open for the future construction of the preliminary settling tanks south of the east half of the plant. Bottom-dump cars of 4-yd. capacity drawn on narrow-gage track by gasoline locomotives transported the spoil from the excavations to the point of disposal, where a stiff-leg derrick lifted the car body off the trucks and dumped the load. This derrick was moved back and forth on rollers along the line of the dump drawn by cables from a dead-man. When grading was done, the spoil was spread by the lighter steam shovel.

Excavation was started in September, 1923, continued through the winter (by dynamiting the frozen ground) and until late in the fall of 1924, then stopped and resumed in the spring. The excavation for the three batteries was complete in June, 1925. An attempt was made to do the bulk excavation of the last battery with the elevating grader and teams; this worked well in dry weather but could not be used in wet ground; nevertheless 36,000 cu.yd. was removed in this way.

Construction Plant—Because of the time limitations on division A and large quantities of materials to be handled over an extensive ground area, special consideration was given by the contractor to construction equipment and plant layout.

The general contractor, the John Griffiths & Son Co., did all the work in connection with the concrete construction. Excavation was done by the W. J. Newman Co. as a sub-contractor. Piping was furnished and placed by the L. H. Prentice Co. Conduits outside the batteries were sublet to the American Sewer & Drain Co. The combined personnel of the construction forces with all the contractors operating was close to 400 men.

The general contractor's plant layout consists of four main units, connected by a system of track work and served by a network of railroad trackage for receiving and storing materials and return of cars. The four main units consist of a cableway supported by two 85-ft. towers, storage bins and concrete mixing plant, a cement storage bin and a small concrete mixing plant for precast units (Fig. 2).

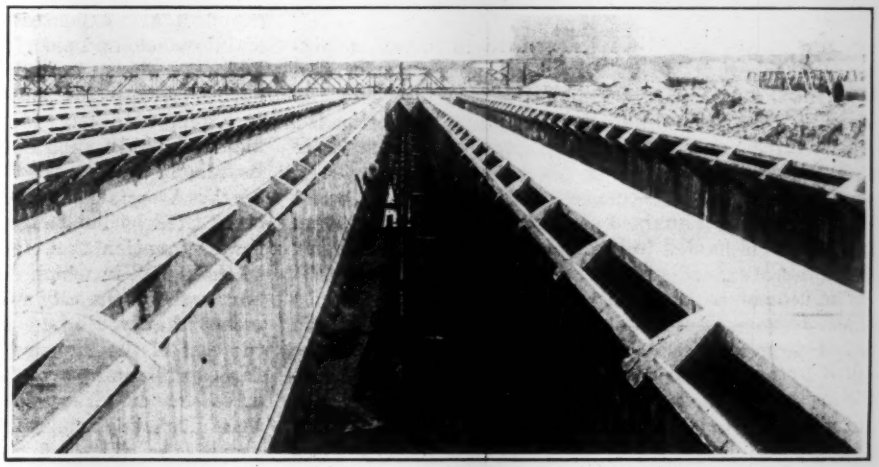


FIG. 11—FILTROS PLATES ARE PLACED ON ONE SIDE OF AERATORS ONLY, TO GIVE SEWAGE CIRCULATORY MOTION
Cast-iron air pipe down center supplies the double row of filtros plates.

The area to be served by the mixed concrete delivery equipment is so large that chuting concrete was con-

sidered impracticable. The use of belt conveyors, buggies or dump cars was also considered. However, when consideration was given to the problem of transporting and placing the steel forms for the concrete and handling other heavy materials and equipment, it was determined that an equipment to handle both placement of concrete and transfer and placement of forms, piping, reinforcing steel, etc., would be the most efficient. Resort was therefore had to towers and an 805-ft. cableway with 15-ton capacity. The towers were so placed, one on either side of the site of the concrete work, that they might move back and forth on an 1,800-ft. travel.

The cableway has been used in placing every yard of concrete in the work, all reinforcing steel, structural steel bridges over the tanks, and all piping. It has transported and placed all steel forms for the concrete; in fact, it has handled practically every pound of material which has been placed either temporarily or permanently on the site of the aeration and sedimentation tanks. It will be used in placing concrete for the grit chamber and preliminary settling tanks at an estimated saving of $20,000 over other types of equipment.

The concrete mixing plant was designed for quantity output. Sand and gravel are delivered by the C. & N. W. onto a trestle constructed over a line of hopper-bottom receiving bins which are centered about the main storage and mixing plant. Aggregates are fed through ports in these hoppers onto electrically operated belt conveyors which carry the materials to a central hopper just below grade, having separate compartments for sand and gravel. Two bucket conveyors lift the aggregates from this central hopper to overhead storage bins having a capacity of 160 yd. of sand and 300 of gravel.

Bulk cement for the heavy concrete work is shipped in paper-lined refrigerator cars, removed from the cars by electrically operated equipment which is hand controlled and delivered to a bucket-elevator system which raises it to two storage bins, each of 10-carload capacity.

Screw conveyors deliver the cement to the main mixing plant where it is raised by a bucket-elevator system to an auxiliary bin of 250-bbl. capacity just over the charging floor. The main mixing plant is constructed in four levels: an upper level for storage, the next lower level for the proportioning plant and charging floor, below these two 1-yd. concrete mixers, and the lowest at grade. Here the mixed concrete is run into receivers in which it is hauled to the foot of one of the cableway towers.

The cement is delivered to the proportioning floor by small dump cars running on narrow-gage track and loaded from overhead hoppers. These dump cars are pulled by hand from the point of loading to the proportioning floor, but on the return are pulled over a hump and pass by gravity down the hump. Cement proportion is maintained by weighing on a scale underneath the discharge opening of the storage bin, where an operator controls the cement quantities by operating the lever of a discharge gate. The coarse and fine aggregates are measured by volume, by one man at each aggregate hopper. Water measurement is similarly controlled. A bell-signal system co-ordinates the operations of the men controlling the supply of cement, aggregates and water. Two electrically operated mixers on the mixing level discharge into a 5-yd. steel hopper. Mixed concrete is delivered through a spout, with a lever-controlled gate, to a bucket on a flat car. Two trains operated on a standard-gage track, each consisting of a small steam locomotive and a flat car with 5-yd. bucket, deliver the concrete-filled bucket to the south cableway tower. The use of two trains required the installation of a passing track with spring switches. The buckets are handled by the cableway rapidly to the point of dumping. The travel of the two towers is synchronized electrically although a 20-ft. variation in alignment of the two towers is possible.

Average daily concrete placement with this plant layout was about 525 cu.yd., based on an 8-hr. day. During one month this average was raised to 650 cu.yd.

Precast concrete units are manufactured in a separate small mixing plant. Cement is delivered to this plant in bags instead of in bulk. Forms for the precast units are mounted on small flat cars operated on a narrow-gage track. After the forms are filled, electric monorail hoists carry the poured units to a steam room to cure.

Various auxiliary equipment was used by the contractor, including a locomotive crane for unloading. A stiff-leg derrick located just north of the main mixing plant is also used when aggregates are delivered in gondolas instead of the bottom-dump cars which are more suitable for the mixing plant as constructed. About a mile of service and storage tracks was installed. Average daily operation required 18 carloads of gravel, 9 of sand and 4 of cement. The contractor's investment in plant and equipment was in excess of $250,000.

Engineering—All general plans and specifications for the Sanitary District's sewage treatment plant program and the feeder sewerage systems are drawn by the engineering staff of the District. Construction is also supervised by engineering representatives of the Sanitary District.

Bonds or Pay-as-You Go for Water-Works

Although the pay-as-you-go policy is sound for meeting ordinary expenses of water-works operation and maintenance, and also for comparatively small renewals and extensions, it is in some cases true economy to borrow money for major capital outlays rather than to attempt to pay for them as the obligations are incurred, said Charles W. Sherman, of Metcalf & Eddy, Boston, in a paper read before the New England Water Works Association on Jan. 12. The possible saving to be effected by bond issues, he said, "is predicated upon the assumption that the credit of the municipality is of the best," in which case the cost of the money when borrowed by the city will be less than the value of the money that would be collected from individuals to meet the cost of the improvements. If the city overborrows for capital outlays or borrows for ordinary expenses, or is slow in meeting its obligations "it is conceivable that ultimately the rate to be paid by the city would exceed the value of money to the individual." The paper (which will be printed in *Journal* N.E.W.W.A.) was accompanied by tables showing the present worth to the individual at 6 per cent of annual payments required upon serial municipal bonds at 4 per cent issued for various terms of years. [References to earlier discussions in *Engineering News*, *Engineering Record* and *Engineering News-Record* of the relative merits of the pay-as-you-go and bond-issue plans of financing public improvements were given in this journal for Nov. 6, 1924, p. 735.—EDITOR.]

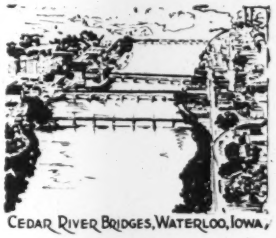
Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

Waterloo, Iowa



CEDAR RIVER BRIDGES, WATERLOO, IOWA.

TYPICAL AGRICULTURAL AND MANUFACTURING CENTER in north central Iowa, being the county seat of Blackhawk County. It is situated on three railroads one of which has its shops here and at the center of a series of radiating state and county paved or graveled highways. Its $25,000,000 investment in 150 manufacturing industries employing 6,000 people produces more than double the amount in products. It makes one-fifth of all the stationary gasoline engines of the farm type and is the third largest producer of cream separators. More small and moderate-sized concrete mixers are made in Waterloo than in any other city in the country. A center for jobbing houses, 800 salesmen travel out of Waterloo. It is the home of the Dairy Cattle Congress and the National Belgian Horse Show, and Blackhawk County boasts of having several of the country's leading herds of beef and dairy breeds of cattle and pure bred hogs. Products of interest to the engineer, made in Waterloo, include backfillers, road drags, tractors, blast hole drills, cement mixers, block machines, skylights, cornices, portable elevators, saw rigs, pump jacks, railroad safety appliances, tank heaters, ventilating systems and well drilling machines. Settled in 1845, incorporated in 1854. Pop. (1925 state census) 36,708.

WATERLOO is in one of the richest of corn belt counties in Iowa. Situated in the lower part of the glacial terminal moraine, its engineering features geologically are decidedly different from those of its neighbor Cedar Rapids, 100 miles down the Cedar River in the black belt country. There, the farmer boy cannot find a stone big enough to throw at the cows, and the stock springtime joke is that good corn land does not make good road material. Iowa north has a fine gravel road system because there is roadside gravel. Iowa south has none. Waterloo is in the Iowa north section and has excellent roads leading into it from every direction.

Like several other cities in the agricultural belt one is decidedly surprised to find that on the prairies has grown, almost over night, the manufacturing town whose products find wide use, particularly in the agricultural belt. This rapid growth has been a problem for the engineer. Additional problems have been imposed by the Cedar River, which cuts the town in half with business sections on the comparatively flat areas on either side where a 6 per cent grade is the maximum street grade. The flat topography is responsible for four automatic sewage pumping stations. The river receives the sewage but the State Board of Health and the Izaak Waltons have made such a fuss with every town on the river from Austin, Minn. (where Prof. Frederic Bass has recently put a disposal plant into operation), to its mouth, that sanitary engineers ought to reap a rich harvest building disposal plants. Fish life may then be restored; cattle may once more drink the water; and the farmer's boy again bathe with impunity, but state officials will have to raise bond limits.

As to bridges (of which there are five) all but one are of reinforced concrete. Here is the first one of that type in Iowa built in 1902-3 on the old Thatcher patent. It is in fair shape today, though jackets have been built around the piers near the water line where the frost and ice ate into them as much as 18 in., exposing the reinforcing. Repairing the piers and putting concrete under those undermined, by the city engineer at a material reduction over a bid price, was largely responsible for a re-election. From the river, then, the engineer's position, well-being and greatest problems are inseparable.

Black top-soil and clay, except for a 600-acre area of sand in Westfield, are found on the west side of the city. The water table is high, so basements are tiled. On the opposite side of the river many outcrops of rock are encountered in trenching. Building sand is found under the surface almost invariably with the ground water down 10 to 12 ft. on the east side. Trenching machines are therefore feasible for contractors' use, though tight sheeting is needed everywhere. Gravel must be shipped in a distance of about 10 miles. Sand is obtained largely from the river. A limestone quarry within the city limits furnishes a good hard broken stone for concrete aggregates at about the cost of gravel.

City Engineering Progress—Caring for street work, sewers and utilities to serve the needs of the ever-expanding city has kept the city engineer busy, but the latest growth projected the city beyond the 1½-mile flood plain onto higher ground. Drainage problems have been simpler and the payment by special assessment has permitted improvements to go ahead uniformly. No annexations have been made since 1916, the area now being about a square in shape of 8,687 acres, traversed from northwest to southeast by the river in 10-ft. banks.

It is not surprising then to find a vault full of well-indexed special-assessment records and maps with a well-worked-out system of handling details and special short-cuts for figuring assessments on irregular-shaped property. Regular-shaped plots are assessed as areas rather than by frontage, in accordance with curves for zones worked out several years ago by the Iowa Society of Engineers.

Ralph B. Slippy is the city engineer, elected along with a mayor, six councilmen, an attorney and auditor. His duties, as defined by law and city ordinance, comprise supervision of sewers, street paving and paving of alleys and sidewalks, bridges and boulevard lighting. He is also engineer for the Park Commission and River Front Commission, though serving at the request of those bodies. He has only advisory charge of maintenance of streets, street cleaning and garbage collection. His staff consists of an office engineer who, with the city engineer, designs most of the work, three assistant engineers and one rodman. This crew is maintained throughout the year, working up plans and records during the winter. Additional rodmen and inspectors are employed when needed. Bridges, sewers, paving, river wall and lighting are the principal works named in order of importance.

Bridges—The bridges require the first attention of the engineer. Besides jacketing the piers of the 24-

year-old Thatcher bridge, rock has been piled around all of the piers of the later bridges. Some repairs have been done to handrails. Four years ago the one Pratt-truss bridge was strengthened and painted by force account with an asphalt asbestos paint. The wood-block pavement now needs replacing. One 1911 and one 1920 concrete bridge have required no repairs to date.

Paving—All paving is done by contract with the contractor waiting until the work is completed for assessments to be spread. He then takes certificates on separate property or bonds which the city may sell. The last two years 10-year bonds with a maximum of 6-per cent coupons have been used. Waterloo is well paved with the exception of a few business streets. Sheet asphalt on a concrete base is the prevailing type.

Engineering Work

The following are the mileages of the various types: Brick, 3.87 miles; brick resurfaced with asphalt, 1.07 miles; asphalt, 69.89 miles; vibrolithic, 0.63 miles; making a total of 75.46 miles of the 209.3 miles of streets. There are 175 miles of concrete sidewalks and crossings, 84.5 miles of combined sewers, 3.88 miles of sanitary sewers and 3 miles of storm sewers. In laying out subdivisions, new streets must conform to and join with existing streets. A state law so requires though council is the authority for approval of plots. Most of the streets are 60 or 66 ft. wide, though the main business

Qualifications for Success and Extent of Service of City Engineers

Abstract of an Address Given Before the Engineers' Club of Kansas City by W. K. Seitz, City Engineer of St. Joseph, Missouri

THE principal qualification of a city engineer is honesty. He is constantly advising laymen who know little or nothing of engineering, and in weighing his opinions it must be upon the assumption that they are honestly given. When a man builds a reputation for honesty he has made the first long step toward becoming a person of influence.

The next two qualifications are tact and engineering knowledge. One's appreciation of the value of tact grows with his experience in municipal work. He soon learns that the most diplomatic way to proceed is to explain carefully any new idea intended for city development to his elected superiors and then quietly watch the proposal with the usual accompaniment of fireworks. Many competent engineers have failed to put their ideas and themselves over, because of their inability to work with and through other persons. I am not belittling professional knowledge, but it alone will not bring success to the city engineer.

The next attribute is not so much a qualification as it is a rule of conduct:

A city engineer must keep out of politics.

Engineers are poor politicians. Conversely, political engineers are poor professional practitioners. There is no necessity for a competent engineer to enter politics. Elected city officials are almost always anxious to make their administrations successful. For this reason they are careful to retain the services of a competent engineer if he has not made himself personally objectionable to the incoming régime.

THERE are minor qualifications that one should have if he is to go far in his profession. He should be of good address—able to express himself clearly and forcefully before a large or small audience. Courage, poise and the ability to mix with his fellows make valuable acquaintances and friends. Sobriety is essential to clear thinking, without which an engineer is lost.

The limits of a city engineer in a city of 100,000 are those placed by the engineer himself. Our complex communal life makes greater demands each year upon him. Almost every civic activity outside of revenue collection requires some engineering service. By being ready and qualified to render this service, the city engineer makes himself invaluable and gives to his position the dignity to which it is entitled.

In the department of public improvements the city engineer is of course the outstanding figure. The design, construction and maintenahce of streets, sewers and viaducts are purely engineering matters. However, many engineers stop here. This may be one reason why we have so many city engineers working for a salary of $2,000 to $3,000 a year.

Let us see what the possibilities for service are beyond this.

THE two main objectives of the police department are crime prevention and traffic control. Traffic is assuming a greater importance each year. Actual direction of traffic is a police function, but traffic regulations are engineering studies and the cities that realize this are the cities that are getting results.

Fire departments in every city are changing from horse-drawn to motorized equipment. Selection of equipment, the working out of effective radii of different apparatus, and the relocation and rearrangement of firehouses to meet the new conditions are problems that the fire chief and the city engineer must work over together.

One of the important functions of the health department is sanitation. Here again the engineer has an opportunity to render service.

The location of parks and boulevards, determination of areas to be utilized for parks and parkway areas, and the improvement of park property should be carried on under the direction of the city engineer to insure proper co-ordination of all public improvement work.

The development of aviation calls for the establishment of an improvement in municipal landing fields. Again we have a call for the engineer, and if he is wide awake he can be of great service.

COURTS and public service commissions have repeatedly held that the basis for a public utility rate is the value of the property. During the last few years while values and operating expenses have been subjected to violent fluctuations, the question of rates that public utilities shall be permitted to charge has been raised often. While I do not say that the city engineer should value these properties, as the work can be done better and more economically by private firms with specially trained organizations, I do believe that he should have a working knowledge of the intricacies that enter into rate-making hearings.

In city planning the engineer comes into his own. Zoning and circulation call for engineering judgment of the highest degree. No one is better qualified to visualize plans made for future generations or to carry on the details of development than the city engineer.

And so I repeat: the field is unlimited and the bounds are where the engineer chooses to place them.

Of the Small City

arteries are 80 ft. wide. In consequence, there is as yet no demand for widening. At the beginning of the 1923 paving program Mr. Slippy proposed increasing the corner curb radius from 10 ft. to 30 ft. to care for automobile traffic. Opposition which developed disappeared with such hearty approval that all subsequent plans call for a 30-ft. radius if it is possible to get it.

Zoning of restricted residence districts has been in effect one year with no test cases so far. Eventually it will operate mainly to stabilize designs of sewer sizes and street widths but so far has had no effect on the city engineer's work.

Sewage—In January, 1924, all the Cedar River towns were called before the State Board of Health and asked to give an estimate, offhand, of the cost of sewage works. The $1,000,000 immediate figure for Waterloo was lowered in the second hearing three months later to $750,000 to include both plant and intercepters. There are three outlets on each side of the river all below the dam, but 2½ miles above any available site. (The dam has a 7-ft. fall and impounded water supplies condenser water for a power plant.) The plant estimated was Imhoff tanks and sprinkling filters. With this expenditure confronting the river cities they got the legislature to require approval of the State Executive Council, consisting of the governor, secretary of state and secretary of treasury, for all expenditures over $5,000. The work cannot proceed in Waterloo without increase in the tax limit which is now within $200,000 of the limit. Sewage disposal, therefore, faces little likelihood of change for some time. Cedar Rapids, 100 miles below, drinks the water but filters it.

Water—Mr. Slippy has nothing to do with the well water supply which is of excellent quality for drinking but hard for industrial use. Five wells, penetrating 1,400 ft. deep to St. Peters sandstone produce a water having a temperature of 54 deg. F.

Engineering in Waterloo is at more or less ebb tide at present because the heavy rate of population growth is past. In consequence Mr. Slippy is enabled to find time for outside consulting work which he is permitted to do. A small sewage-disposal system for camp grounds has just been completed. A report with recommendations on the condition of the Grinnell plant has recently been made. To make a good living any engineer in Iowa must step lively and the present Waterloo incumbent is on the job several more hours per day than the allotted 9-to-5 city office hours.

Notes on Municipal Port Operation at Charleston, S. C.

By J. Russell Wait
Gen. Mgr., Port Utilities Commission of Charleston, S. C.

THE month of July, 1925, marked the end of three years' operation of the terminal acquired by the city of Charleston, S. C., as a municipal property. The city authorized the issuance of $2,500,000 in bonds, and of this $1,255,953.22 has been spent. This money bought certain property and over eleven miles of standard-gage railroad, mostly in the streets of Charleston and all within the corporate limits. The property is scattered and consists in three parcels of real estate, all fronting on Cooper River, having a total water frontage of 4,375 ft.

The act creating the commission requires that the interest on the bonds be paid semi-annually, amounting, in all, to $122,500 yearly, and also provides that a sinking fund be set aside to retire the bonds at the end of 40 years. Thus the total interest and sinking fund requirements are $138,898.72, which amount represented a little more than 35 per cent of the gross income of the property in 1924.

The Port Utilities Commission is making intelligent and consistent efforts to develop the facilities it has in charge and to make them productive of business, and in this policy it has extended, and must still further extend, the scope of its operations. Unless these are made in a large way, with the single purpose of furnishing facilities for all interests seeking to use the port for the handling of freight, and without regard for special and severely local interests, it is patent that it must fall short of public satisfaction.

The property included in the port comprises three main pieces. The Columbus St. Terminal consists of the pier parallel to Cooper River, of sufficient length to berth four cargo steamers, with tracks parallel to the vessels. At this plant an average of 300 tons per hatch is regularly handled, and when it is desired by the owner of the cargo, 400 tons per hatch can be discharged. By the addition of electrically-operated side-dump cars and by the replacement of the steam hoist by an electric one, the tonnage that can be handled over this particular apparatus will be doubled. At this wharf, electric lift trucks have been installed, equipped to handle both package and bulk commodities. Electrically-driven box-car loaders and conveyors are used.

The new Union Pier extends to the harbor line and is perpendicular to the flow of Cooper River. Two steel sheds are on the north and south sides of the four depressed tracks, and berthing space is available for three large cargo vessels at one time. This pier is of modern construction and will be used solely for handling high-class package cargo. As part of the mechanical labor-saving equipment, a locomotive crane is used in handling all heavy commodities. This is supplemented by four-wheel trucks, carrying solid sling loads, and roller conveyors for package freight.

The Port Terminals are served, without switching charge, by all three railroads entering Charleston.

The Port Terminals plant consists of 88 sections of warehouses, each unit being completely isolated by firewalls, and protected by individual sprinkler systems. The whole represents the finest possible warehouse and wharf layout equipped with adequate trackage, deep water (30 ft. at mean low water, and a wharf 2,060 ft. long), and adequate to berth five vessels at once of the type common to Charleston. Behind these warehouses is a remarkable system of electrically-operated machinery that has great possibilities for development to handle special commodities.

Serving the wharves of the city the commission operates a belt-line railway serving all warehouses and wharves on its line. The road is a Class Two switching road and assures equal service to all industries. Dredging of the commission's properties is done by the commission with complete equipment for dredging and handling 1,200 yd. daily. Four locomotives perform the switching of the belt-line railway and during October, 1925, 9,000 cars were handled.

Eleven Dams Make Storage Reservoir of Lake Kenogami

Storage of 15,000,000,000 Cu.Ft. Provided—Muck and Boulder Formation Made Difficult Excavation—Winter Concreting Furnished Interesting Lessons—Embankment Cofferdams

By A. F. Dyer
Chief Engineer, Nova Scotia Construction Co., Ltd.,
Sydney, N. S.

A round dozen dams, dikes and fills are making Lake Kenogami in Quebec into a 15,000,000,000-cu.ft. storage reservoir for water power on the Ausable and the Chicoutimi rivers. Several of these structures are dams of respectable size and one is a structure which ranks high among big dams in America. The structures therefore warrant consideration for their own importance, but it is the development as a whole that is most significant as illustrating an activity which is particularly the function of the Quebec Streams Commission.—Editor.

LAKE KENOGAMI, which means long lake, is about 18 miles long and varies from ½ to 1 mile in width. It lies to the southwest of the Saguenay River and south of Lake St. John. Its tributaries drain 1,450 square miles. The lake has two outlets, the Chicoutimi River and the Ausable River, each of which has a total fall of about 500 ft. to the Saguenay. The existing power installations on these two rivers are 31,000 hp. on the Chicoutimi River and 32,500 hp. on the Ausable.

Some years ago the users of this power had added to the storage capacity of the lake by the construction of timber dams across the two outlets, thus raising the low water level about 9 ft. This, however, did not provide sufficient storage to operate through the winter months and additional storage was found to be necessary. The works to be described were built for this purpose by the Quebec Streams Commission, a department of the Provincial Government, to which the users will pay annual rentals, based on the head developed, for the water supplied to them. The old dams controlled the level of the lake up to El. 92 above the datum used. The new works will raise the high water level to El. 115, providing a total storage of 15,000,000,000 cu.ft. and allowing for a minimum flow of 1,800 sec.-ft. continuously through the year.

The works required for this storage consisted of the main dams across the Chicoutimi River at Portage des Roches and the Ausable River at Pibrac, and of six other cutoff dams or dikes situated at various localities around the lake as indicated on Fig. 1. The contract for the work was awarded in March, 1923, and preparations were immediately made to proceed with the construction. As it was a provision of the contract that the work was to be so advanced that the lake level might be raised to El. 108 in April, 1924, it was necessary to carry on the construction of the majority of the structures at the same time.

Chicoutimi River Dam—The largest structure is the dam across the Chicoutimi River at Portage des Roches about 15 miles from the town of Chicoutimi. It is a concrete structure having a length of 1,500 ft. and a maximum height of 80 ft. Fig. 3 is a section and Fig. 2 is a general view. There are eleven sluices 8x8 ft., eight of which have their sills at El. 78, two at El. 85 and one at El. 91. Each sluice is controlled by a steel gate. In addition there are two log sluices, each 12 ft. wide with sills at El. 96.67 and El. 105 respectively, and 20 spillways, each 15 ft. wide with sills at El. 107. Stoplogs close these openings when not in use.

It was necessary to provide a continuous flow of at least 1,200 sec.-ft. to the users on the Chicoutimi River and plans had to be made to carry out the unwatering of the river section and the construction of that part of the dam in two operations. A timber crib was built

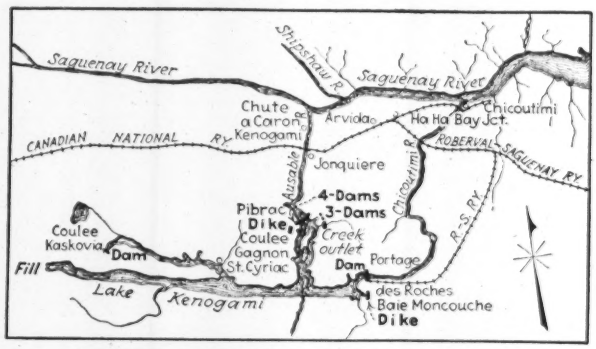


FIG. 1—SKETCH MAP OF LAKE KENOGAMI DAM LOCATIONS

Eight dams and dikes increase low water elevation some 32 ft. above original level and create a reservoir of fifteen billion cubic feet. There are now some 63,500 hp. developed on the Chicoutimi and the Ausable. On the Saguenay just off the map is the Isle Maligne development of ultimately half a million horsepower.

out from the south bank above the dam site to about the middle of the river and there joined to a similar cofferdam running longitudinally down the river to a point below the dam where a small cofferdam to the south bank completely enclosed the area to be unwatered. This cofferdam is shown by Fig. 4.

No special difficulty was encountered in this part of the work and early in September, 1923, the waterwheel sluice and sluices 1 and 2 had been built. As these sluices were not of themselves large enough to pass the river, it was necessary to leave a gap or temporary opening in the bulkhead section of the dam immediately to the south of the gate-section for this purpose. The concrete foundation in the opening was poured to El. 76 and three piers built projecting in front of the face of the dam for holding the stoplogs which would be required when it became necessary to fill in the opening with concrete. From El. 89 the concrete was roofed over the opening, two vertical shafts 2x3 ft. in section being left for the pouring of the concrete in the opening, the ceiling of which was sloped to each shaft to insure proper ramming and a tight joint.

As soon as these operations were completed the cofferdam from the middle of the river to the north

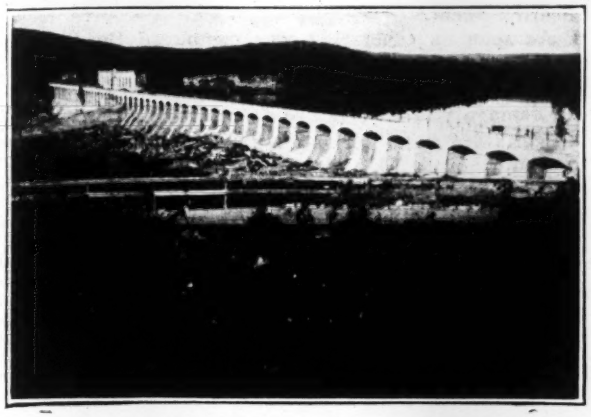


FIG. 2—COMPLETED PORTAGE DES ROCHES DAM FROM NORTH

Carrying a roadway 17½ ft. wide its full length on buttress piers the dam presents a handsome appearance against the wild background of wooded hills.

bank was closed, a cutoff having been built joining the cross-river cofferdam to the concrete last poured and the south portion of the cofferdam removed. This diverted the river to the south so that it passed through the temporary opening and sluices 1 and 2.

To handle the excavated material from the foundations and to facilitate the placing of plums in the concrete a substantial timber trestle, Fig. 4, had been built alongside the upstream face of the dam with its deck at El. 96. On this trestle were two five-ton stiffleg traveling derricks, each with a 55-ft. boom. These were most useful for handling cofferdam material and moving pumps at this stage of the work. When pumping was started in the north half of the river section, it was found that the leakage was greater than the pumps could handle. A secondary cofferdam was then built under the trestle from which a wooden flume conveyed the excess water across the foundations and discharged it downstream.

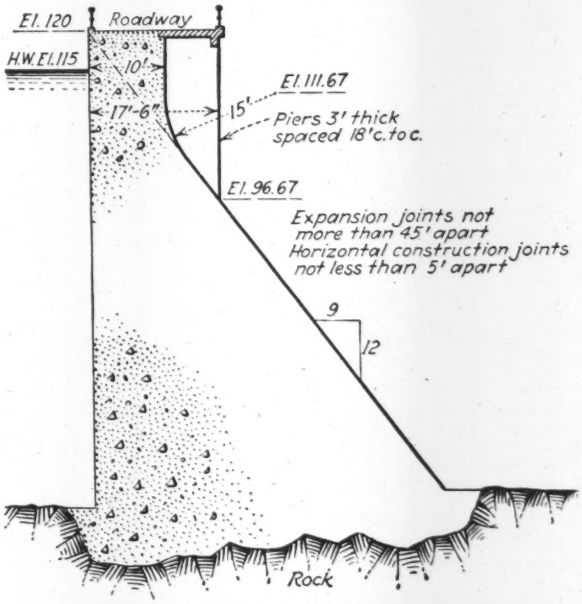


FIG. 3—SECTION OF LARGEST DAM AT PORTAGE DES ROCHES

This structure is 1,500 ft. long and 80 ft. high and called for some 36,000 cu.yd. of concrete much of which was put in in freezing weather.

The river bottom was here found to consist of a mixture of boulders and fine sand with the rock dipping sharply on each side. It was soon realized that a considerable amount of excavation to an unknown depth would be necessary before a suitable foundation could be obtained and that it would be advisable to get rid of the wooden flume as soon as possible as its existence, owing to the unstable bottom, greatly added to the risk of flooding. A concrete flume was therefore formed by pouring a 10-ft. wide section of base on the foundation adjoining sluice 2, and the wooden flume was removed.

Wakefield sheetpiling was then driven upstream and downstream of the excavation and digging was proceeded with both day and night. Owing to the quicksand nature of the material the work was frequently interrupted by blow-ins and it was not until Jan. 14, 1924, that the bottom was reached at El. 38.

One of the chief troubles here was due to the fact that the upstream cofferdam was too close to the excavation. This was unavoidable owing to the location of the old dam, the sluices of which had to be kept clear. The old timber dam was situated about 150 ft. above the site of the new dam and it was in such a leaky condition that no use could be made of it as a cofferdam. Had the rock in the river bottom been found

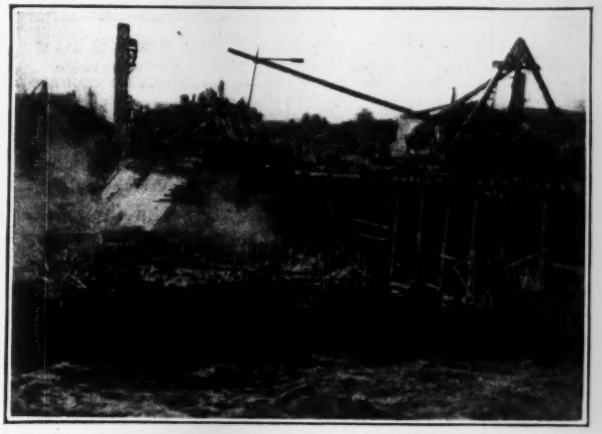


FIG. 4—CONSTRUCTION IN PROGRESS AT PORTAGE DES ROCHES

This shows operations on Sept. 1, 1923, in cofferdam one. Note the concreting tower and traveling derricks. The diverted stream is in the close foreground.

where it was expected as indicated by the original surveys, the nearness of the cofferdam would not have been felt, but under the conditions encountered as the excavation proceeded the material on which the trestle as well as the secondary and primary cofferdams were built became unstable and considerable time had to be spent in strengthening these structures.

Owing to this condition it was not possible to excavate the whole foundation at one time but comparatively small sections were cleaned out on which blocks of concrete were poured from which braces could be set to support the sheetpiling before the adjoining section was excavated. The difficulty of this part of the work was considerably increased by reason of the severe winter conditions under which the pumps and other machines had to be kept in continuous operation.

The construction of the rest of the dam had meanwhile been carried on from both ends. The north end of the dam from chainage 0 to 686, including the spill-

ways and logsluices, was sublet to Gorman & Peckham, who completed their part of the work in November, 1923. An arrangement was then made with the subcontractors that their plant would be left so that it could assist in completing the concrete work of the river section which, it was foreseen, would now have to be poured under winter conditions in order that the structure would be completed before the spring floods.

The concreting plant on the north side consisted of a one-yard mixer, loaded from overhead bins which were kept supplied with material by a clamshell derrick. While waiting for the foundations in the river section to be prepared a supply of about 3,000 cu.yd. of crushed

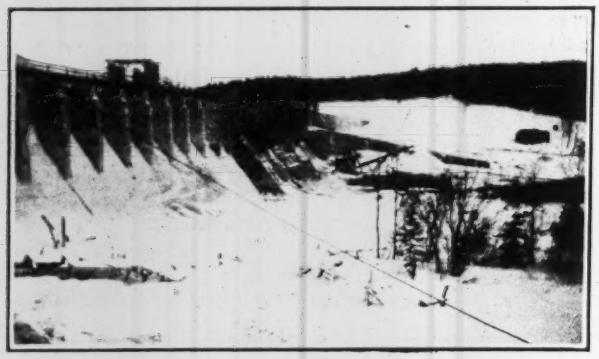


FIG. 5—WINTER WORK AT PORTAGE DES ROCHES DAM
This picture was taken on March 4, 1924. A considerable portion of the dam was concreted at temperatures from 10 to 20 deg. below zero Fahrenheit.

rock was got ready for this plant. The construction of the south end of the dam (all bulkhead section) was carried out by the general contractors, whose concreting plant consisted of an S-28 mixer having overhead bins supplied by clamshell derrick.

During January and February the temperature was seldom above zero Fahr. and as a rule varied from 10 to 20 deg. below that point with a minimum recorded temperature of —35 deg. It was therefore necessary to adhere to the following methods in carrying out concrete operations:

1. The forms and rock foundation, or previously poured concrete, which were to be in contact with the new concrete had to be cleaned of all ice and warmed. This was done by covering over the section with large tarpaulins and keeping several stoves burning under the cover for at least twelve hours previous to starting the concreting. Heating the section by steam was not found to be as suitable as by stoves as the escaping vapor readily formed ice. Hot water was found to be the most efficient means for the removal of ice and snow.

2. The temperature of the freshly mixed concrete was maintained around 70 deg. F., and it was protected against exposure to cold as much as possible. This temperature was obtained by heating the sand and water by steam jets. The stone and cement were not generally heated but the exhaust from the mixer engine was so arranged that it could be discharged into the drum of the mixer when desired.

3. Once concreting was commenced it was proceeded with as rapidly as possible. (With the two mixing plants in operation we were able to pour from 40 to 50 cu.yd. of concrete per hour.) No plums were placed owing to the expense which would have been entailed in heating them.

4. As soon as concreting was completed the green concrete was covered over with tarpaulins under which steam jets were inserted.

No damage was experienced from frost, although at this dam 7,244 cu.yd. of concrete were poured between Dec. 1 and March 15. Records were kept of the temperature in the concrete after pouring by readings taken on the thermometers which were lowered down pipes built into the work during construction. It was found that the temperature of the concrete rose during the first twenty-four hours to between 110 and 120 deg. F., after which it usually dropped gradually, taking two or three weeks to reach 32 deg.

Much has been said and written lately regarding the economy of carrying on construction work during the winter months in Canada. From the point of view of the owner or user, as in the case in question, it will often be advisable to pay the extra cost of winter work in order to have the use of the structure several months sooner. The engineer also need have no fears for the quality of the work, for with proper precautions taken, the results obtained in the winter generally compare quite favorably with work done during the warmer months. The contractor's viewpoint however, may be very different unless he is well protected with a special price for winter work, for to perform good work of the nature here described in a temperature which persistently remains below zero for weeks at a time is an expensive undertaking.

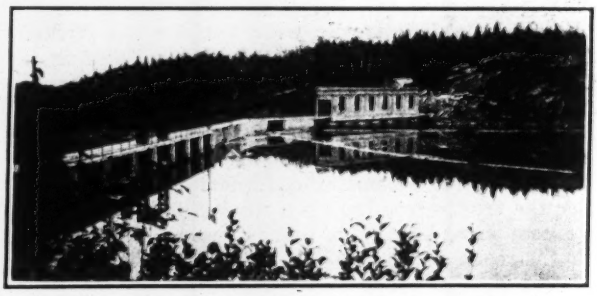


FIG. 6—EAST PIBRAC DAM FROM UPSTREAM
Views shows pond level at El. 110 or some 27 ft. above the original low water level of the lake.

In zero weather it was found that the carpenters' output was less than 50 per cent of their normal, that from one to two hours were often lost in the mornings in shoveling snow, thawing out machines, uncovering forms, melting ice, etc., and that the consumption of coal was doubled if not trebled. Mechanical breakdowns are much more frequent in severe weather with resulting loss of time, while the difficulty of washing off rock foundations preparatory to concreting in subzero weather can best be realized after it has been experienced. It was found that the cost of winter work was from one-third to one-half higher than similar work in mild weather.

The concreting of the river section was completed on March 10, 1924, after which the sluice gates and their winches were installed and the cofferdam and old timber dam removed in readiness for the spring floods. A start was made on May 5 to build the forms for the reinforced-concrete roadway, which was completed early in June. The gatehouse, enclosing the gate

winches, is a concrete building 175 ft. long by 18 ft. high. It contains a 3-ton overhead traveling crane for handling the machines and gate parts. This was completed in July and the whole structure handed over on August 15. The principal quantities in this dam were:

Excavation	14,063 cu.yd.
1:2½:5 and 1:2:4 mass concrete	34,934 cu.yd.
1:2:4 reinforced concrete	1,015 cu.yd.
Steel and iron	194 tons

Access to the site of the dam at Portage des Roches presented no difficulties as the standard-gage railway tracks of the Roberval-Saguenay Ry. ran to within a few feet of the works. All the plant was therefore unloaded at the scene of operations, a siding was run in alongside a cement storage shed into which the cement was unloaded direct from the cars. A short narrow-gage track on the other side of this shed was used for conveying the cement to the mixer as required.

Ausable River Dams—The dams across the Ausable River at Pibrac consist of four separate structures, as they are located where the river is divided by an island. They are the east dam, bulkheads 1 and 2, and the west dam. The latter contains three gate sluices, two with sills at El. 85 and one at El. 91, also two log sluices and four spillways. In design it is similar to

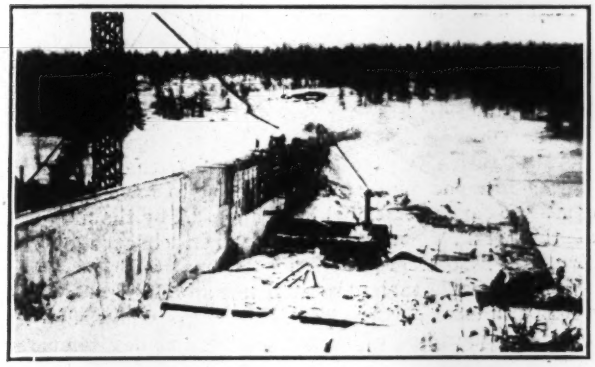


FIG. 7—COREWALL CONSTRUCTION AT CREEK OUTLET DAM
This shows outfit for winter operations as of Jan. 4, 1924.

the dam at Portage des Roches with the exception of the roadway which was omitted at Pibrac.

There being two channels at this site it was allowable to close each one in turn, but owing to the higher elevation of the sluices at the west dam, it was necessary to raise the water level in the lake before the east channel could be closed. It was therefore decided to construct the west dam in 1923 and to throw a cofferdam across the east channel early in 1924 in which there would be sluices to pass the required flow from the lake until such time as the water had risen high enough to pass in sufficient quantity by the west channel, after which the construction of the east dam could be proceeded with.

No special conditions of particular interest were met in the construction of the west dam which was completed, with the exception of the gatehouse, by the end of 1923. Bulkheads 1 and 2 were also built during the same season as well as the seven spillways and the bulkhead section of the east dam up to El. 110.

It was originally thought that the bottom of the east channel was solid rock, as it was so indicated on the contract plans, but it was discovered that the formation was practically the same as that met with at Portage des Roches. A modification of the plans therefore had to be made. In place of the ordinary type of stone filled, timber crib and plank sheathed cofferdam which it was first proposed to build, it was decided to close the channel by means of a rock-fill dam, blinded upstream by a heavy earth and sand fill, which type of cofferdam was considered to be a safer one for the poor foundation conditions discovered in the river bottom.

As sluices could not be placed in this type of dam, a canal was excavated around the site with sill level at El.

FIG. 8—DAM AT BAIE MONCOUCHE
Earth fill with concrete corewall on steel sheetpiling. Stone repropping on upstream face.

80 in order to pass the water during the low water period of the lake. The rock from this canal was used for making the rockfill dam. The canal was controlled by stoplogs placed upstream from the line of the dam. The lake was then allowed to rise slowly to El. 102, at which level it was maintained throughout the year.

The leakage under the rock and earth-fill cofferdam was considerable, amounting to about 6,000 gal. per minute. A secondary cofferdam was therefore built which impounded this leakage at El. 90 and from this pool a flume was run through a tunnel excavated through the adjacent river bank and discharged into the canal below the stoplogs. The leakage which passed the secondary dam was caught and pumped into this flume.

Downstream of the dam site, where the head of water did not exceed 25 ft., a rock-filled crib cofferdam, sheathed with 2-in. plank and with a heavy earth toefill was used with good success. It was here found necessary to carry the toefilling for a considerable distance in front of the dam in order to stop the percolation of water through the boulder formation under the cofferdam.

In addition to the excavation for the dam foundations, which had to be carried down some 23 ft. lower than anticipated, the sides of the channel had to be excavated for a width of 88 ft. down to El. 76 in order to provide the necessary width for the six sluice gates at El. 78.

Concrete work was started on Sept. 9 and the gate section was completed up to El. 120 on Oct. 30. The gates were immediately set and the gatehouse concrete completed on Nov. 15 just as the weather suddenly turned cold. A logsluice was then constructed in the canal above mentioned and the balance of the concrete work completed by Dec. 19, 1924. The rock-fill cofferdam was removed during the winter and early spring by excavation methods. The total quantities of work at Pibrac were:

Excavation	17,210 cu.yd.
Concrete	23,574 cu.yd.
Steel and iron	136 tons

As Pibrac is situated four miles from the Canadian National Ry. at Jonquiere, all plant and cement had to be hauled by teams or trucks from the cars to the site of the works. Sand also had to be hauled by teams a distance of about two miles.

Small Concrete Dams—The largest of the cutoff dams was built at a location known as Creek Outlet, about one mile south of Pibrac, Fig. 7. This dam is a gravity section concrete wall 500 ft. long and 45 ft. high at the deepest section. About 6,000 cu.yd. of 1:2½:5 concrete were poured in this dam, the greater part of it being constructed during winter weather. Two other small concrete bulkheads were built at Creek Outlet across depressions which were below El. 120. A similar concrete dam was built at Coulee Kashouia near the north end of the lake at a location which is 22 miles by road from the railway at Jonquiere, the nearest station.

Dike Construction—Of the two remaining structures, the dike built at Baie Moncouche, at the extreme south end of the lake, was the more interesting. This end of the lake is blocked by a sandy formation whose surface elevation was around 100 and which lies between two rocky hills about 500 ft. apart. The contract called for a concrete corewall carried 10 ft. into the ground and supported on each side by earth filling having a 3:1 slope upstream and a 2½:1 slope downstream. On the trench being excavated and borings taken it was found that the formation was deeper and more porous than expected and it was decided to drive a continuous line of steel sheetpiling 30 to 40 ft. in length, under the corewall.

The concrete wall and earth filling were brought along and followed closely after the driving of the piles and the dam was completed in December, 1923. When the lake was raised in the following spring it was found that water was passing under this dam in spite of the sheetpiling, the leakage increasing as the lake level went up. As a safeguard against a possible washout and in order to consolidate the sand foundation on which the dam rests a rock fill has been made on the downstream side of the dam which contains about 45,000 cu.yd. of rock.

Another earth dike was built at Coulee Gagnon near Pibrac. Here a peat bog was encountered and was entirely removed for the width of the dam. A clay and boulder formation underlying the bog provided a suitable foundation for this dam without the need of sheetpiling.

When Lake Kenogami had been raised to El. 102, flow of water took place to small lakes to the north, but was stopped by the placing, under another contract, of some 1,750,000 cu.yd. of sand fill between the low hills at the north.

The raising of Lake Kenogami to El. 115 has caused the flooding of eleven square miles of country, including the village of St. Cyriac and the main road from Jonquiere to Lake St. John. The villagers of St. Cyriac were paid liberally for their holdings and had to find new quarters. A new road was constructed from Jonquiere to Hebertville, a distance of 19 miles. The total cost of the undertaking, including compensation for flooded lands, will be nearly four million dollars. The construction of the dams was carried out under the direction of O. Lefebvre, chief engineer of the Quebec Streams Commission, by the general contractors the Nova Scotia Construction Co. of Halifax and Sydney, N. S., the writer serving as chief engineer.

How to Prevent and to Restore Frozen Concrete

The Effect of Frost Upon Freshly Made Concrete With Suggestions on How to Discover and Restore Frozen Concrete

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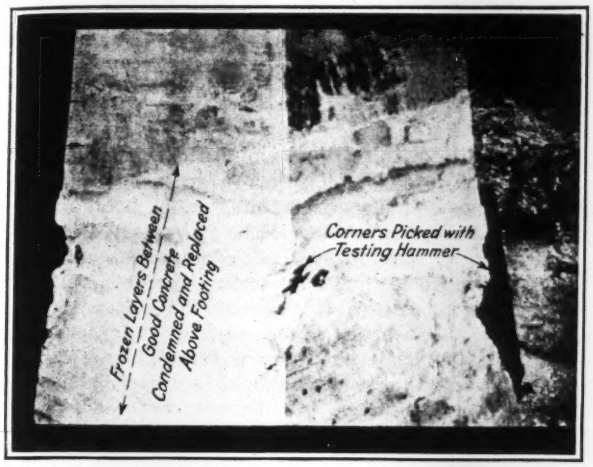
MUCH has already been written on the subject of methods for heating concrete aggregates and for protecting freshly placed concrete against the action of frost, but so far as the writer knows, nothing has yet been published on the subject of restoring frozen concrete and very little on the action of frost on freshly poured mixtures. In our Northern States, Canada, Alaska, and in the portion of Europe that is subjected to severe winters, there has been considerable railroad winter construction carried on, including a large amount of concrete work, notably on bridge and other foundations. In addition, there have been within the past few years some successful examples of reinforced-concrete buildings, some of them of very large size, built during more or less severe winters in many of our American cities. Unfortunately, among all of these various winter activities, there have been some failures due to improper protection against frost, where freshly poured concrete, improperly sheltered, actually froze. As the concrete looked solid after the premature removal of forms (a practice more popular than justified) it was in some instances considered to have set sufficiently to carry additional loads imposed by the progress of the work, eventually resulting in collapse of the structure before construction was completed.

It is probable that in most if not all of these failures a careful examination dictated by the knowledge of weather conditions of current night and day temperatures—easily available during the progress of the work—and a few properly placed maximum-minimum thermometers at different critical points within and outside of the forms, some suspicion if not actual knowledge of the true facts would have resulted, leading to further investigation before removing the forms, thus rendering such catastrophes as failures of concrete structures due to frost a practical impossibility, if subsequently handled properly.

What Freezing Does—The expansion of water at the moment of freezing develops minute separations of the concrete mass, the intensity of the disruptive force varying in proportion to the amount of water in the mixture and to the extent of setting already reached when the influence of freezing overcomes the process of hydrolysis.

Investigations made by the writer, however, indicate that while wet concrete that has frozen will expand more than a dry mixture exposed to similar conditions, less injury results to wet than to dry concrete when thawed and allowed to set properly. This is apparently due to two reasons: (1) the greater plasticity of wet mixtures, which enables them to contract when thawed and resume their normal condition and displacement; (2) the loss of moisture caused by the additional evaporation resulting from the extra time through retarded hydration, which saps the vitality of dry mixtures but has no particular effect on mixtures that contain a slight excess of water because the loss due to evapora-



CONCRETE PIER FROZEN DURING PLACING

tion is replenished through the excess water contained in the mass.

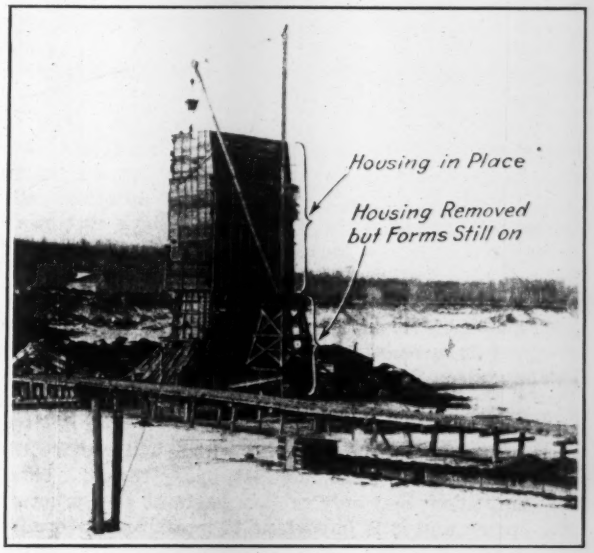
Tests show that no serious ultimate injury results to ordinary plastic mixtures that have been frozen, thawed, and then properly protected against further frost action and allowed to harden, especially when proper curing methods are used. However, the uncertain elements that may enter into action under actual working conditions show that no risks should be taken and that concrete should never be allowed to freeze, but if, as has unfortunately too often happened, it is found that the concrete on a job has frozen, the use of intelligent and experienced care may restore it to very near, or possibly to full efficiency, providing that it was not exposed to repeated freezing and thawing.

Thawing Concrete—Frozen concrete should be allowed to thaw and set very gradually. The forms should first be thoroughly inspected and any weak points noted so as to provide for retightening and additional bracing as may be considered necessary, or advisable. It may happen that the freezing has followed from the bottom upward through the successive pourings or layers so that the lower portion of the forms would therefore require considerable reinforcing in order to hold the mass when thawed out. The writer knows of similar instances when the forms broke and the concrete spilled out like thick molasses.

The thawing of frozen concrete is a responsibility requiring care and good judgment. A thorough study of the conditions will dictate the proper system to apply and the proper auxiliary bracing to use should any be required. In most cases, as far as is practicable, the thawing should begin at the extreme bottom and, if possible, be continued gradually upward in sections not exceeding 8 or 10 ft. in height or, if it is a building, not more than one story high at a time. Uniform heating protected by satisfactory housing should be provided on all sides. Steam heating is preferable, not only because it is more uniform, easier to control and less hazardous on account of fire risks, but also because it provides a satisfactory means of curing the concrete when the proper stage in setting has been reached, through the creation of moisture provided by steam allowed to escape from the coils. The preferable temperature to provide within the housing is 50 deg. to 60 deg. F., care being taken not to overheat, particularly if the concrete was a dry mix.

The cooling of freshly poured concrete has a very weakening effect upon the coalescing properties of the cement in the mixture, particularly along those faces of the structure that are most exposed, and, if gradually increasing in intensity, will check the chemical action, so that when the temperature of the mass reaches about 35 deg. F. the process of hydration will practically have come to a standstill. However, in the case of mass concrete the effect, if due to action of frost which originally affects only the outside, will not at first be seriously felt within the interior of the mass owing to the fact that the internal heat developed as a result of the chemical action of setting will offset the inroads of frost until overcome by still colder temperatures. In such event it would be quite possible to have a core of set or partly set concrete surrounded by a shell of frozen concrete.

Unprotected or insufficiently heated thin walls, partitions, floors, etc., as in reinforced-concrete buildings, are particularly susceptible to the effect of sudden drops in temperature and particularly to cold winds, their thinness making it possible for the frost to penetrate



RAILROAD BRIDGE PIER IN SASKATCHEWAN, WHERE CONCRETE WAS PROTECTED AGAINST FROST
Stone crusher and aggregate heating bin made of logs for winter concreting.

the full cross-section quite rapidly once it has obtained a good hold on the exposed face.

Repeated Freezing—The effect of the first freezing is to cause extremely fine irregular fissures throughout the mass which, upon thawing will fill with water drawn from the surrounding body. If the concrete is then protected against further frost and allowed to thaw, these fissures will gradually close and eject the surplus water which is then reincorporated into the surrounding mass. Any excess water, as in the case of wet concrete, is displaced by the heavier ingredients compacted by their own gravity, which forces the bulk of the surplus water to the surface and through joints in the forms, some being also absorbed by wooden forms, just as would have happened if the concrete had not frozen.

The effect of the second freezing—assuming this to take place shortly after the first thawing, or before the equilibrium of the mixture has been re-established—is to enlarge the fissures caused by the first exposure and

to add tiny radial cracks, this progressive course resulting in further forcible separation of the multiple units that form the mass. If the concrete is then allowed to thaw and set, the 28-day test of ordinary plastic mixtures will probably indicate a loss of 20 to 30 per cent of its strength, dry mixtures losing even more. Some of this loss, varying possibly between 5 and 10 per cent, might, however, be made up on the six months' test but this is not dependable, particularly with dry mixtures.

Further exposures to freezing and thawing such for instance as might occur as the result of alternative cold nights and warm days, when the interval of thawing is insufficient to allow for the incipience of hydration, will eventually render concrete inert for any practical purpose, some tests showing that there remained only 30 to 50 per cent of the ultimate strength of ordinary plastic mixtures after the fourth exposure, this representing a loss of strength of 50 to 70 per cent, which would keep on increasing on further exposure until practically no cementing value was left.

Restoring Frozen Concrete—As indicated above, concrete that has been exposed to one period of steady freezing without any intervals of partial or complete thawing can be restored to practically 100 per cent efficiency providing that proper measures are taken in the thawing and subsequent curing. Intelligent care must be used and all doubt should first be eliminated by thorough investigation carried out systematically throughout the structure. This will involve cutting or boring holes into the forms (but not into the concrete surface) sufficiently to permit close inspection and testing. Such holes need not be over two or three inches in diameter but should be so located and spaced as to permit of decisive information, particularly on the sides that have been most exposed to inclement weather.

Frozen concrete can usually be known by its color but the best and most decisive test is to pour a little warm water on it, the effect of which will remove the frost immediately from the face being tested. These tests may show that only certain parts of the structure have frozen and it is important to locate and determine such areas and penetration as closely as is possible. To assist in recording this and to aid in the study and preparation of proper thawing remedies, skeleton elevations or planes of the surface should be drawn on a small scale on which the exact location of the test points and information as obtained will be indicated. The inspection openings should be plugged carefully in such manner as to insure a continuous smooth even surface in line with the inside face of the forms so as to avoid unevenness at these points after the concrete has set, while also insuring against undue leakage of the water used in subsequent curing.

The next step will include the tightening and strengthening of the forms and possible additional bracing so as to provide sufficient resistance against pressure of the thawed concrete and of any tributary loading from the construction conditions as existing at the time. This should be followed by a satisfactory system of housing and heating that will insure gradual thawing and eventual complete hydration of the concrete.

Form Removal—Curing is necessary to insure the quality of concrete. Under winter conditions, satisfactory curing can be provided by the controlled escape of steam from the steam heating coils located between the forms and housing. This keeps the forms moist and this dampness prevents the escape of moisture from the concrete that is required to complete the process of hydrolysis. Another method of winter curing is to allow warm water to flow between the forms and face of the concrete at intervals, keeping the forms wet.

It is the writer's opinion that in order to insure the best results the curing of retaining walls, bridge piers, abutments and pedestals should be two weeks and reinforced-concrete structures three weeks, this applying both to summer and winter work. The forms should be kept on if possible throughout the full period of curing unless intended to be re-used on other parts of the work in which event more water will be required for curing and the housing should be maintained until the curing is completed. In districts exposed to very severe frost, it is preferable to keep the forms on at least one month but the housing can be removed as soon as the curing and heating are discontinued. During hydration the concrete will develop heat reaching to about 100 deg. F., while the temperature of the outside air might in some districts reach — 25 deg F.

The early removal of forms, which is sometimes carried to extremes without apparent reason, is particularly objectionable in winter when concrete in the early stage of hardening, when its acquired strength might be less than a quarter of its ultimate resistance, is suddenly exposed to a change of temperature of 100 deg. or more. This results in uneven stresses, particularly active on the faces, which produce numerous small cracks. If for any good reason it becomes necessary to remove the forms in two or three days, the housing should be kept on so as to enable the carrying on of heating and curing and protection against the effect of frost until the concrete has attained at least two-thirds of its desired ultimate strength.

Research Needed—It is hoped that this article, the writer's humble contribution to what is a needed field of investigation, will result in the making of tests and other inquiries by technical bodies of universities and others, into the subject of frozen concrete, in line with experiments that so far have been carried on mostly in Europe and in regard to which little is generally known in this country, although we now probably carry on more winter concrete work than is done in all other countries of the world combined. Some of the testing laboratories of Europe, particularly those at Rome and Zurich, are equipped with freezing machines and many years ago initiated the making of tests of different concrete mixtures so as to ascertain their comparative resistance to the action of frost. The studies at these and at other large testing laboratories in France, Germany, England not only cover the testing of frost action but also of other elements injuring concrete.

The writer offers the suggestion that, since our winter concrete output is already large, and, thanks to publicity on winter construction afforded by the investigations of the Hoover Committee and recent articles in various technical publications, will likely further expand, it would be a boon to the winter concrete construction industry if a few of our testing laboratories would make special studies of the destructive elements including frost action liable to affect concrete, with the view of ascertaining the best way to save, or protect, or repair, any concrete structure that might be affected by such.

Flood Control in the Southwest and Elsewhere

Problems of the South Canadian and Pecatonica Rivers—Federal Interest in Flood Control

VARIOUS aspects of the flood prevention and control problem were presented in a series of papers at the recent meeting of the National Drainage Congress, this subject being one of the main features of the proceedings. Abstracts of some of these papers are given below. The situations at Wichita, Kan., and Pueblo, Colo., which were the subject of other papers, have been described fully in *Engineering News-Record.*

The South Canadian River

BY A. S. STINNETT
Texas Commissioner of Flood Control

WITH a length of 1,000 miles and a drainage area of 60,000 sq.mi. the South Canadian River is a most important unit in the Arkansas River system, but there is less authentic record as to its average runoff than that of any other stream of comparable size in the United States. During the past twenty years, spasmodic efforts have been made to gage the runoff, but in no year was the record complete, owing to the automatic gage being washed away or the channel being changed by floods, making it necessary to re-draw the rating curve. The nearest complete record was at Logan, N. M., in 1904, when the gage showed a runoff of 1,558,387 acre-feet. From long observation and the destruction of railroad bridges the runoff is known to be stupendous, almost unbelievably so when heavy prolonged rains on the watersheds in New Mexico synchronize with the torrential rains in Texas and Oklahoma.

The 68th Congress passed a bill authorizing a preliminary survey of this and other rivers with a view to control of their floods, under the Act of 1917. Reconnaissance surveys were made by War Department engineers, followed by engineering studies by the city of Amarillo, assisted by Oldham County, in collaboration with engineers of New Mexico. The results of the work in Texas were the location of dam and canal sites, and the measurement of drainage, irrigable and storage areas. Three dams more than 100 ft. high will give storage capacity for 500,000 acre-feet each and provide for hydro-electric development; large areas of fertile land are available for irrigation; continuing losses of railway and highway bridges will cease, and additional bridges can be built to supplement the present two highway bridges on the full 200-mile stretch of the river in Texas.

[The flood control committee of the Oklahoma Chamber of Commerce submitted at this meeting a project for the control of the river in that state by means of a number of dams and reservoirs at the heads of tributary streams, with one dam in the main stream. In some places, canals would divert flood water from the river to natural storage basins. —EDITOR.]

* * *

Flood Protection for Freeport, Ill.

BY W. G. POTTER
Drainage Engineer, Illinois Division of Waterways

IN A record of the discharge of the Pecatonica River, at Freeport, for 10½ years, an average of 119 days showed less than 500 sec.-ft., while on four days in the ten years the discharge amounted to 14,000 and the highest record was 17,000 sec.-ft., in 1916. This corresponds closely to the studies made by engineers of the Miami Conservancy on storms occurring once in 25 years. To insure safety, the flood discharge was assumed as 25 per cent greater than the maximum record, or 21,000 sec.-ft. This town, with 20,000 population, occupies both sides of the river; the business section on the south side is on high ground, but the manufacturing district on the north side is below high-water line and much of it is flooded sometimes as often as once a year. In 1916 the loss due to damages, wages lost, shops closed and transportation interrupted was estimated at $100,000. The river has a tortuous course above the city, and has low banks in loamy clay subject to erosion by strong current. In the city it is 110 to 160 ft. wide and there is a dam and power plant, with 4 ft. head at medium low water. For high-water stages there is an auxiliary steam plant.

With the dam removed, capacity for a flood of 21,000 sec.-ft. would require a channel of 280 ft. top width, involving the purchase of much high-value property and the lengthening of bridges. Relief projects provide for diversion channels around the city, for about 2 to 2½ miles, at costs of $660,000 to $780,000. To offset this cost, the site of the present channel, filled with soil from the new channel would be utilized by the railways and factories and would pay taxes to the city and county. With the river in its present location, long intercepting sewers would have to be built through expensive property to a treatment plant; but if the diversion is made, one intercepter could be built along the abandoned channel.

* * *

Federal Interest in Flood Control

BY RILEY J. WILSON
President, National Rivers and Harbors Congress

IN 1917 Congress passed a law which delimited what should be considered flood control work and provided the means for investigation and report on flood-control projects. The first project adopted by Congress under this Act was for flood control on the Mississippi River and the Sacramento River, in both of which the federal and local contributions work out at about 50 per cent for each. Work on the Mississippi is linked with navigation, but serves also to protect the levees which limit the channel and prevent floods over extensive territory. Work on the Sacramento River includes flood control, reclamation and navigation. The flood situation at Pittsburgh is being surveyed under the provisions of the Act of 1917, and it is believed that a system of reservoirs near the headwaters of the Allegheny and Monongahela rivers will be practicable, releasing water for the improvement of navigation on the Ohio during seasons of low water. At the last session of Congress a bill was passed authorizing preliminary surveys of a number of rivers in the east, central and western states. In large projects it is seldom that the various states or localities concerned can agree upon a plan or a division of expenses. Therefore, even where the government surveys show no federal interest or share in expense of flood control projects, these surveys are valuable as being thorough and unbiased, affording a basis for agreement.

* * *

Value of Flood Control

BY C. A. BOOK
Vice-President Dayton-Morgan Engineering Co.

SUCCESSFUL completion of the protective work at Pueblo, Colo., speaks well for the spirit of the citizens. The cost is a considerable burden, but without flood protection the depreciation of property values would have been very great and a permanent bar to progress. Flood insurance is becoming more or less common, but some Pueblo merchants found that the cost of such insurance was considerably higher than their assessment for flood-control works. Furthermore, flood protection is much more than insurance. The latter gives security only to a part of the physical property; it does not prevent a great disaster to the community or the attendant widespread depreciation in values and demoralization of business.

It is difficult to appraise the value of security from floods. All over the country are communities that live under a flood menace. It is not a question of whether they need protection, but whether the expense is justified. Cloudburst rainfall has occurred in many sections. Denver may be visited by a flood that will dwarf the Pueblo disaster in comparison. Council Bluffs has for forty years been considering means of relief, but meanwhile it pays large sums annually to maintain an inadequate channel and to clean flood sediment from the streets. A cloudburst might do appalling damage. In Erie, Pa., since its flood of 1915 the city has constructed flood-control works. A similar problem developed at Richmond, Va. Experience with situations like these indicates that a community will seldom make a big investment in protection works until the necessity is proved through an actual flood disaster.

Batten-Plate Columns: Their Status and a Design Theory

American and European Attitudes—Faults in the A.R.E.A. Tests—A Proposed Method of Calculation

By R. Fleming and W. H. Weiskopf
American Bridge Co., New York City

Part I—By R. Fleming

MENTION of batten-plate columns in a number of recent contributions to technical literature has led to the writing of this article. To cite a few recent references:

Dr. E. H. Salmon in an article, "Column Fallacies" *(The Structural Engineer,* March, 1924*)* lists as a fallacy the statement that batten-plate columns are unscientific in design. "There is no reason," he says, "why a satisfactory batten-plate column should not be designed." The handbook of Dorman, Long & Co., Ltd., 1924, illustrates "Types of Bases and Caps for Stanchions" with a figure for "double channels with battens" and another for "double channels with flats." Edward Godfrey, in his book "Engineering Failures and Their Lessons," 1924, condemns the use of battened columns *in toto,* but too sweeping conclusions should not be drawn from the failure of the short column of rather abnormal design which he cites as an illustration. Swain's "Structural Engineering," 1924, shows a column composed of two channels latticed together (Fig. 383 of the book) and by its side a column of the same shape "with batten plates at intervals" (Fig. 384).

Present Practice—In the early days of iron highway bridges, batten plates were frequently used instead of lacing bars in struts and columns. Professor Robinson gave them a place in his "Strength of Wrought-Iron Bridge Members," 1882 (No. 60 of Van Nostrand's Science Series) although he did not fully meet the question of strength. At present they are a thing of the past in the United States, though still used by European designers. Empirical requirements are found in most bridge specifications regarding batten plates at the ends of latticed compression members and where latticing is interrupted.

Salmon in his noteworthy book, "Columns," London, 1921, states that it is possible to make a battened column as efficient as a latticed column and to do so at less cost. He cites Emperger, who concluded from experiments he made that latticed bracing is a useless expense in materials and labor. Krohn, Müller-Breslau and Engesser are also mentioned as writers who have given special attention to the theory of battened columns. The usual theory, Salmon continues, is as follows:

> Let F_s be the longitudinal shearing force on the group of rivets connecting a batten plate to a flange. Then $F_s h = Qj$, where Q is the actual shearing force on the batten plate, j the pitch of the batten plates, and h the distance apart of the flanges. Hence $F_s = Qj/h$. The bending moment on these rivets is $\frac{1}{2}F_s h = \frac{1}{2}Qj$. Therefore the rivets and the batten plates must withstand a longitudinal shearing force $F_s = Qj/h$ and a bending moment $\frac{1}{2}Qj$. Q may be given its value under working conditions, namely, 1 per cent of the longitudinal load.

While the shear in columns fabricated for laboratory testing may not exceed 1 per cent of the load in the commercial column it is usually more.

Swain in his book already cited writes, "Obviously each channel acts by itself to resist a length equal to the distance between connections of the latticing or between batten rivets." He goes on to say that it is not sufficient that l/r for the separate part be equal to the length-ratio of the whole column, since the end conditions may not be the same. "The separate part should be considered as the ideal pin-ended column, even if the column as a whole is fixed-ended." He says that this condition will be met if l^2/cr^2 for the segment, with the constant c for pin ends, is equal to the same term for the whole column with its appropriate value of c.

A. R. E. A. Tests—A remarkable series of column tests made by the U. S. Bureau of Standards in co-operation with committees of the American Society of Civil Engineers and the American Railway Engineering Association is reported in Vol. 19 (1918) of the American Railway Engineering Association *Proceedings.* The battened columns made a poor showing, so much so that the first of the conclusions is, "Columns in which batten plates are substituted for lacing bars will not develop the full strength of the member and should not be used."

Column 1M, shown in Fig. 1 herewith, failed at 15,000 lb. per sq.in. It is observed that the l/r of this column as a whole as well as the l/r of the unsupported portions of each single channel is 120. The manner of failure is shown by Fig. 2. Column 1L, Fig. 3, failed in the manner shown by Fig. 4 at 24,000 lb. per sq.in. The l/r of this column as a whole is 80 and of the unsupported portion of each single channel 85. Salmon may have had some of these columns in mind when he wrote, "It is quite true, of course, that batten-plate columns often are unscientific in design. They have been designed by solid-column formulas, without the slightest regard to secondary flexure. The batten plates and rivets have been arranged without any reference to the shear forces which will come upon them, and when disaster has been the result the type of column has been condemned instead of the designer."

Consider 1M, the weakest of the battened columns tested. There was certainly no regard paid to secondary flexure in its design. The stress due to secondary flexure depends upon the transverse shear. Many specifications require that the latticing of compression members be designed to resist a transverse shear equal to 2 per cent of the axial load. Strictly speaking, the transverse shear varies as the slenderness ratio l/r. As these columns were fabricated specially to be tested, the transverse shear may not have exceeded 1½ per cent of the axial load. Assuming this value, the transverse shear for the load at failure (15,000 lb. per sq.in.) is 2,810 lb. The bending moment at the outer rivet of a batten is (see Fig. 1) $\frac{2{,}810}{2} \times \frac{72\frac{1}{8}}{2} = 51{,}060$ in.-lb. The section modulus of each channel in the weakest direction is 1.1 for gross section and 0.83 for net section. From the basic equation $f = M/S$, the stress in the extreme fiber of each channel is $51{,}060/1.1 = 46{,}420$ for gross section and $51{,}060/0.83 = 61{,}520$ for net section. The maximum compressive fiber stress due to the load at which the column failed is thus $46{,}420 + 15{,}000 = 61{,}420$ lb. per sq.in., and the maximum tensile stress is 61,520 lb. per sq.in.

The moment on the rivet group of each channel is

1,405 × ½ × 77⅛ = 54,580 in.-lb., which divided by 5, the distance in inches between outer rivets of batten plates, equals 10,920 lb., the shearing stress on two rivets (one in each flange of the channel) or 5,460 lb. per rivet.

Again, by the formula 16,000 — 70 l/r, the allowable compressive stress or axial load on the column is 7,600 lb. per sq.in. or 95,000 lb. total. Assuming battens to be placed 36 in. between outer rivets instead of 72⅛ in., the compressive fiber stress with a transverse shear of 2 per cent of the axial load, or 1,900 lb., is 15,550 + 7,600 = 23,100 lb. per sq.in. and the tensile stress is 20,600 lb. per sq.in. The shearing stress on each outer rivet of batten plates is ½(41 × ½ × 1,900)/5 = 3,895 lb.

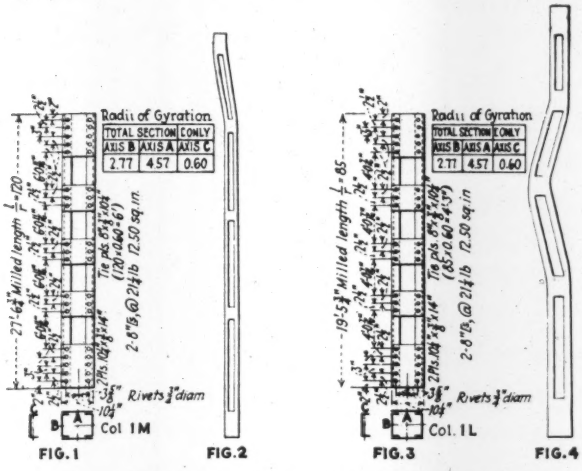


FIG. 1 FIG. 2 FIG. 3 FIG. 4

FIGS. 1 TO 4—FAILURES OF TWO COLUMNS IN THE A. R. E. A. TEST SERIES

It is readily seen that batten plates to be fully effective should be spaced much closer than has usually been done. It is also inferred that if battened columns were thus designed they would not be economical.

Whether a column should be condemned because batten plates are used instead of lacing is quite different from a question of design. In the words of Professor Swain, "The structural engineer who is charged with the maintenance of bridges, such as the railroad bridge engineer, has continually before him the question as to how far he may allow the actual stresses to exceed those used in designing, before he condemns a structure, that is how far the factor of safety may be safely encroached on ('Structural Engineering,' p. 537)."

* * *

Part II—By W. H. Weiskopf

A mathematical discussion of battened columns encounters many difficulties, and for practical use an approximate solution must be used. The following approximate analysis may be found useful. It will be assumed that (1) the batten plates are sufficiently strong and have enough rivets to fix the channels in direction; (2) the batten plates do not rotate as the column deflects; and (3) points of contraflexure exist midway between batten plates.

According to these assumptions a batten-plate column (Fig. 5) will deflect under load as shown in Figs. 6, 7, or 8. Which of these curves the column will assume depends on the variation in symmetry and homogeneity along its length, just as the lack of perfect symmetry determines on which side of the neutral axis a solid-web column will deflect.

Obviously Fig. 8 represents the most severe condition. The maximum combined stress occurs at point X. A portion of the column adjacent to this point is shown separately in Fig. 9. The deflection, d, is given as in the derivation of Gordon's formula by the equation

$$d = \frac{al^2}{c} \qquad (1)$$

where a is a constant, and c the distance from the neutral axis to the extreme fiber. The value c enters into this equation as half of the width of the member, which is a measure of the rigidity of the section. It is not associated with the extreme-fiber stress as is usually the case in the theory of flexure. In applying eq. (1) to a channel section, therefore, one-half of the flange width of the channel should be substituted for c. Eq. (1) then becomes,

$$d = \frac{2al^2}{f} \qquad (2)$$

The total load P applied at the axis of the column in its undeflected position is divided between the two channels inversely as their distances from this axis. The load on the more heavily loaded channel at the point of contraflexure above the point X is, therefore (see Figs. 8 and 9),

$$P(\tfrac{1}{2} + md/h) = P(\tfrac{1}{2} + 2mal^2/fh) \qquad (3)$$

where m is the number of intermediate batten plates,

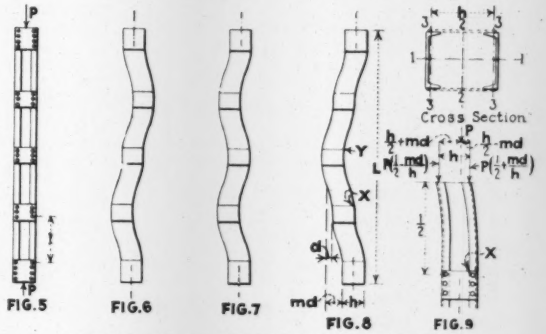


FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9

FIGS. 5 TO 9—DEFLECTION FORMS OF BATTENED COLUMNS

and h the distance between the centers of gravity of the channels. The intensity of direct stress is then

$$\frac{P}{A}\left(1 + \frac{4mal^2}{fh}\right) \qquad (4)$$

where A is the gross sectional area of the two channels, it being assumed that the rivet shaft in filling the hole takes its proportion of compression. The bending moment in the channel is

$$\frac{Pal^2}{f}\left(1 + \frac{4mal^2}{fh}\right) \qquad (5)$$

and the extreme-fiber stress from bending is

$$\frac{Pal^2}{fs}\left(1 + \frac{4mal^2}{fh}\right) \qquad (6)$$

where s is the net section modulus of one channel about axis 3-3, Fig. 9. The combined stress, k, is the sum of (4) and (6), or

$$k = P\left(\frac{1}{A} + \frac{al^2}{fs}\right)\left(1 + \frac{4mal^2}{fh}\right) \qquad (7)$$

from which we obtain

$$P = \frac{k}{\left(\frac{1}{A} + \frac{al^2}{fs}\right)\left(1 + \frac{4mal^2}{fh}\right)} \qquad (8)$$

Eq. (8) thus gives the allowable load, P, for a batten-plate column. The constants a and k are the same as in Gordon's formula. If the flanges of the channels are turned away from each other, instead of toward each other as shown, the maximum combined stress occurs at point Y, Fig. 8, and is given by eq. (8). Although derived for an even number of panels, the term in which m occurs is so small that eq. (8) can be used for an odd number of panels with small error. Therefore it is a general equation for channel columns braced with batten plates.

This equation is rather cumbersome for design purposes. The following equation has been found to give values of l, the distance between batten plates, so the column has equal strength about axes 1-1 and 3-3:

$$l = L\sqrt{\frac{fs}{I\left(1+\frac{L}{225R}\right)}} \qquad (9)$$

in which I is the net moment of inertia, and R the radius of gyration of the column about axis 1-1. A batten-plate column can then be designed by one of the usual methods for structural columns, provided the distance between batten plates does not exceed the value of l in eq. (9).

The fault with many batten-plate columns built in the past is that the batten plates have been placed too far apart. This accounts for the unsatisfactory behavior of this class of columns and the disrepute into which it has fallen.

The bending moment in the two rivet groups between one channel and two connecting batten plates is twice the moment given in eq. (5). In general the number of rivets in batten plates is excessive. It is evidently unnecessary to place more rivets in these two groups than will develop a bending moment equal to twice the net bending moment of the channel about its weak axis.

It will be interesting to compare results obtained by eq. (8) with the A. R. E. A. column tests made by the U. S. Bureau of Standards, previously referred to. Photographs of three of these columns showed the manner of failure. Tests 185 and 196 failed by bending of the channels at the center batten plate, evidently corresponding to a neutral curve like that of Fig. 8. Test 187 failed by bending of the channels at one of the uppermost intermediate batten plates, showing a neutral curve like that of Fig. 6 or Fig. 7. Eq. (8) can be adapted to this case by making m equal to unity. The accompanying table shows the ultimate loads on these columns, the loads computed by eq. (8) and the corresponding safety factors.

RESULTS OF A.R.E.A. COLUMN TESTS MADE BY U. S. BUREAU OF STANDARDS

Test Number	Col.	Ultimate Load in Pounds	m	Load in Pounds by Eq. (8)	Safety Factor
196	1L	311,000	3	78,000	4.0
185	1K	248,000	4	70,000	3.6
187	1M	187,000	1	46,000	4.1

In computing this table a was taken as 1/11,000 and k as 16,250.

It is not known how the remaining columns failed. However, by making m equal to either the number of intermediate batten plates or unity, safety factors varying from 3.6 to 4.2 are obtained.

Methods Used in Testing Yields of Water-Works Wells

By G. C. Habermeyer and C. V. Swearingen
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Excerpts from a paper read Jan. 29 before the Illinois Society of Engineers.

WHEN measuring the yields of wells in regular daily operation we operate the pumps at the same rate and as long as usual so that test conditions are normal.

We measure the yield of a well in a reservoir when possible and when no reservoir is available a small tank or barrel is sometimes used. Occasionally a meter is installed on a discharge line or a weir is used, while at some places it is necessary to estimate from pump strokes. M. L. Enger has used a small tank with orifices in the bottom, the discharge being determined by the number and size of orifices and the depth to which water stands in the tank, that is, the depth of water on the orifices. At some places water is pumped from a reservoir continuously and the amount of water withdrawn is measured by meter or pump stroke. In such cases we try to shut down all well pumps for a time in order to check meter readings or service pump discharge, by measurement in the reservoir.

The yield of a well depends in part on the depth to which the water level is drawn down in the well, and measurements to water level are made when possible. A weight attached to a cord or wire may be lowered into a well and note is made, by the sound, when the weight strikes water, unless other sounds are too numerous. When considerable space is available a wood float, with a weight in the lower end to hold it vertical, may be used instead of the weight. Where very little space is available a thin sheet of lead attached to a cord or insulated wire is used. The lead and cord are chalked with blue chalk which readily shows a water line.

Where an electric lighting circuit is available it is often used in making measurements to water. One end of an insulated wire, protected so that it cannot touch the well casing or other metal, is lowered into the well. The other end of the wire is connected to one terminal of an electric lamp, and the other terminal of the lamp is connected to the lighting circuit. When the end of the wire lowered into the well touches water the circuit is completed and the lamp is lighted. As two wires are used in the lighting circuit, and it is not usually possible to tell in advance which is carrying the current to the lamp, we use two lamp sockets, each connected to a wire of the cord.

In some places a light circuit is not available and at times the insulation on the wire lowered into the well may be found to be badly worn. We then use an electric circuit of low voltage. One or two common electric dry cells and a buzzer or an electric bell are connected in series. The electric circuit is completed by current flowing through an insulated copper wire to a metal cap on a wooden float and from the metal cap through a copper wire back to the dry cells. The float is protected by a metal cylinder. The terminals of the wires with which the cap on the float comes in contact are separated by hard rubber. In the apparatus used the bottom of the float is held away from the walls of the cylinder to reduce friction. When the float is lowered in a well and reaches water the rise of the float closes the electric circuit. The principal trouble experienced with apparatus of this kind is that the terminals corrode easily. On the one we have here we have platinum points and a disk of a platinum substitute called palau.

In a few places we find air pipe of definite length installed in a well. A gage to record pressures can be attached to the pipe and air can be turned in or pumped in with a tire pump. When pumping at a low rate so that friction is negligible the maximum pressure shows the depth of water blown out of the air pipe.

Occasionally we use a magneto, such as is used in testing electric circuits that have high resistance. One terminal of the magneto is connected to an insulated wire with a protected point which is lowered into the well and the other terminal is connected to the ground or the well casing. The handle of the magneto is turned and when the wire touches water the circuit is completed and the bell of the magneto rings.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Rapid Building Demolition by Use of a Pile Hammer

BUILDING demolition often necessitates as much ingenuity by the contractor as does erection. On a two-story reinforced-concrete garage at 61st St. and Central Park, New York City, it was important that the building be demolished in a minimum of time so as not to interfere with the steel erection schedule. Ordinary wrecking methods would have required several months, but the contractor, by using a 5,000-lb. pile hammer, removed the building complete in less than 25 working days and at a less cost than the original estimate. The pile hammer was used to wreck the floors, curtain walls and columns.

REINFORCED CONCRETE BUILDING WRECKED BY USING A PILE HAMMER
Note how reinforcing steel is removed from concrete.

Before adopting the hammer, the method was tried of dropping a heavy steel ball from a considerable height onto the floors. This not only proved ineffective, but the ball bounced to such an extent as to be dangerous.

As shown in the illustration, an 18-in. length of pipe pile, 16 in. in diameter and 1⅛ in. thick, was placed under the head of the hammer. A cable running over the top of the hammer and through diametrically opposite holes in the pipe permitted the hammer and pipe to be handled as a unit from the drop line of a derrick. Holes were pounded in the floor on about 30-in. centers penetrating to the reinforcing steel. A partial opening of the air valve proved more satisfactory than when full air pressure was used. The use of the pile hammer had the advantage of not only rapidly demolishing the building, but of jarring the reinforcement loose so that a few cuts with a blow torch made it available for the junk dealer.

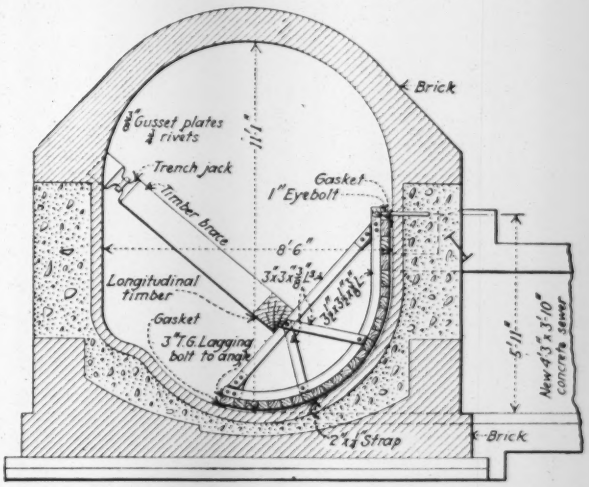
The curtain walls were demolished by removing the pipe and setting the hammer legs over the walls. In one instance, the hammer penetrated 12 ft. of 6-in. curtain wall in about 6 min.

The contractor doing this work was Spencer, White & Prentis, New York City.

Unique Bulkhead Design for Connecting New to Existing Sewer

CONSTRUCTION of new subways invariably gives an opportunity for or makes necessary the reconstruction of many existing underground structures. On one of New York City's new subways, in the Borough of Queens, it became necessary to construct an entirely new sewer of reinforced concrete 4 ft. 3 in. by 3 ft. 10 in. in section. This sewer was to be connected into an existing sewer of combination brick and plain concrete construction as shown in the illustration. The existing sewer was 11 ft. 1 in. by 8 ft. 6 in. in cross-section and had a flow line that was normally about 4 ft. above the lowest point of the invert. During an ordinary storm, however, the sewer ran full and under considerable pressure.

Since this sewer served a large area, it was urgent that its service should not be interrupted. The new sewer was therefore built up to the existing sewer and made ready for connection. A bulkhead of a hinge-gate



HINGED BULKHEAD FOR CUTTING-IN A NEW SEWER

design as shown in the illustration was worked out by the engineers of the Oakdale Contracting Co., New York City, which is carrying on the subway work.

The bulkhead was built in the sewer on a platform erected for that purpose. The curved angles had been previously bent around a templet accurately made to

conform exactly to the sewer section that was to be removed. The bulkhead, when completed, was swung down into place and made tight by timber braces and trench jacks. The heels of these braces rested in niches cut in the brick wall while the opposite ends butted against a longitudinal beam that distributed the pressure of the braces over the bulkhead. After the bulkhead was securely fastened in, the part of the existing sewer behind it was torn away, the new sewer connection made and the bulkhead removed.

The overall length of the bulkhead was 12 ft., consisting of 3-in. tongue-and-groove lagging held together by four rib trusses as shown. The bulkhead was hung from eye-bolts fastening to these truss ribs at the top. All work was done from the platform permitting the men to stay out of the sewage. The obstruction to sewage flow was not appreciable.

Bridge Loadings and Engine Ratings

By G. L. Staley
Assistant Bridge Engineer,
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THE engineering department of the M-K-T Lines has in use a convenient steel bridge record book, sheets of which are shown herewith. Table I is a typical sheet on which the usual information concerning steel bridges is shown. In addition to the usual Cooper's design loading, a column giving the loading that is considered the greatest to which the span may be subjected, is given. The limiting capacities are arrived at by using unit stresses of 24,000 lb. for steel and 20,000 lb. for wrought iron in tension and these unit stresses minus $80\,l/r$ for steel and iron in compression. Each member in the span is so rated, and the one giving the lowest result when converted to terms of Cooper's loading, determines the limiting capacity of the span. Full A.R.E.A. impact is used in arriving at limiting capacity as well as design capacity.

The engine sheet was prepared by rating engines of all classes in use on the road in terms of Cooper's loading, using span lengths that are practically standard on all divisions. In the through-truss spans, the engine is rated on the member which was found to be the weakest as outlined above. When the span rating and the engine rating are equal, or nearly so, the unit

From Job and Office

Hints that Cut Cost and Time

TABLE I—DATA ON STEEL BRIDGES ON M. K.-T. R.R.

Bridge Number	Old Number	Name of Opening	SUBSTRUCTURE: No Abutment Kind	No Abutment Built	Piers No	Piers Kind	Piers Built	So Abutment Kind	So Abutment Built	SUPERSTRUCTURE: Ctr Ctr Trusses or O-O of Girders	Face to Face of Backwalls	Material	Capacity: Design	Capacity: Limiting	Fabrication: Year	Fabrication: Fabricator	Erected	Originally Installed	Weight	Drawing Number	Remarks.
6607		Highway Overxing			1	Piles	1922	Conc	1922	102'-1" ½TRCT		Ir & Steel			1892	Pencoyd Br Co.	1922	5216		352 53	Rebuilt 1921 M-K-T of T
6619		Highway Overxing			182	Conc	1922			164'-2½" TPCT		"			1892	" " "	1922	5433		352 75	" 1922 "
					3	"	1922			102'-1" ½TRCT		"			1892	" " "	1922	5183		352 53	" 1922 "
					4	"	1922			196'-1½" TPCT		'			1893	" " "	1922	4998		352 69	" 1922 "
																					SHERMAN BRANCH
P 670 7			Piles	1922				Piles	1922	60'-0" DPG		Steel	E-50	E-78	1917	Wisconsin Br & I Co	1923		54500	352 190	AFE T-1374
																					HENRIETTA DIV
G 690	1047	Timber Cr	Conc	1906	1	Conc	1906			104' 1" TPG		Steel	E-60	E-98	1923	Wisconsin Br & I Co	1924		270053	353 82	AFE T-1384
								St & Conc	1906	60'-0½" TPG	165'-0"	"	E-40	E-62	1902	" "	1906		73958	353 58	
6 707 9	1091	Pecan Cr	Stone	1872				Stone	1872	76'-6" TPG	77'-9"	"	"	E-65	1898	Pencoyd Br Co	1898		105630	353 24A	
G 707 2	1314		Conc	1919	1	Conc	1919			60'-0" TPG	60'-9½"	"	"	E-62	1909	King Br Co	1920	D 7647	74208	353 57	AFE T 245
G 708 1	1417	Dry Elm Cr	"	1906				Conc	1906	144'-0" TRCT	146'-9"	"	E-60	E-93	1923	Wisconsin Br & I Co	1924	"	357279	353 84	AFE T-1385
G 708 3	1517	Belknap Cr	"	1906				"	1906	144'-0" TRCT	147'-0"	"	"	"	1923	" " "	1924		356013	353 84	AFE T 1386
G 708 5	1547	East Fork Wichita Cr			1	Conc	1906	"	1906	104'-9" TPG	104'-9½"	"	"	E-98	1923	" " "	1924		269631	353 82	AFE T 1387
G 774 6	1565	Little Wichita Cr	Conc	1917	1	"	1923			72'-0" TPG		"	"	E-92	1923	" " "	1924		152459	353 87	AFE 2-89
								Conc	1917	125'-0" TRCT	201'-2½"	"	"	E-90	1923	" " "	1924		284050	353 88	AFE 2-89
																					DENTON BRANCH
K 733 3	078	Hickory Cr	Conc	1910				Conc	1910	172'-7" TPTr Int	177'-6"	Ir & Steel	E-25	E-35	1873	Kellogg & Maurice	1910	1911	328500	352 111	Rebuilt 1895 M-K-T R R Co
K 741 1	084	Elm Cr	"	1906	1	Conc	1906			175'-0" TPCT	178'-3"	Steel	E-40	E-59	1910	King Br Co	1911		276733	353 61	
																					MINEOLA BRANCH
H 722 8	973	Sabine Riv	Conc	1906				Conc	1906	96'-0" TPCT	99'-1"	Ir & Steel		E-31	1893	Youngstown Br Co.	1907	10425	71198	353 23	On falsework Rebuilt 160 Tr
																				353 51½	Repaired by King Br Co 1907
																					SAN ANTONIO DIV
846 3	684	Waco Cr	Conc	1903						60'-0½" S & TPG		Steel	E-40	E-62	1901	Wisconsin Br & I Co	1901		71326	353 8	South Bound Track
859 5	696	Little Cow Bayou	Conc	1907				Conc	1903	60'-0½" S & DPG		"	E-50	E-91	1913	Phoenix Br Co	1913		61410	353 74	North Bound Track
862 1	698	Big Cow Bayou			182	Stone	1887	"	1907	84'-7⅞" DPG	85'-8⅛"	"	E-40	E-65	1899	Pencoyd Br Co.	1899		93100	353 9	
86 5	703	Deer Cr	Conc	1901				Conc	1901	150'-0" DPCT		"	"	E-58	1906	King Br Co	1906		236680	353 47½	
870 5	705	Big Elm Cr	"	1901				"	1901	84'-6" DPG	86'-2"	"	"	E-66	1901	Wisconsin Br & I Co	1901		83963	353 11	
876 8	710	Little Elm Cr	"	1901				"	1901	84'-6" DPG	86'-2"	"	"	"	1901	" " "	1901		84183	353 11	
885 8	724	Little Riv.			1	Cyl Conc	1881			150'-0" TPCT		"	"	E-58	1900	Pencoyd Br Co	1900		216+42	352 10	
					2	Conc	1917	Conc	1917	35'-0" DPG		"	E-50	E-77	1916	Wisconsin Br & I Co	1917		32500	353 75	AFE T-645
897 2	730	Darrs Cr	St & Conc	1900				St & Conc	1900	124'-5⅛" TRCT	127'-3"	"	E-40	E-60	1900	Pencoyd Br Co.	1900		173956	352 21	
904 1	737	Donahoe Cr	Conc	1907	1	Conc	1907			20'-0" I-Beam		"	"	E-61	1907		1907		7643		
					2	"	1907			60'-0½" TPG.		"	"	E-62	1898	Pencoyd Br Co	1907		75037	353 25	
								Conc	1907	20'-0" I-Beam	102'-4½"	"	"	E-61	1907		1907		7643		
U 918 8	U-12	Bear Cr	St & Conc	1900	1	St & Conc	1900			150'-0" TPCT		"	"	E-58	1903	American Br Co.	1904		219100	353 30	
U 921 9	U-15	San Gabriel Riv	Stone	1900	1	Stone	1900			48'-6" DPG		"	"	E-54	1912	" " "	1913		31167	353 66	
					2	St & Conc	1900			200'-0" TPCT		"	"	E-59	1903	" " "	1904		349380	353 28	
					3	Conc	1922			100'-0⅛" ½TRCT		"	"	"	1901	Wisconsin Br & I Co	1922	9132	149919	353 35	AFE T-1088
					4	"	1922			84'-6½" TPG.		"	"	E-62	1906	" " "	1922	A-22	125504		AFE T-1088
U 931 9		I & G N Railroad	Conc	1904				Conc	1904	60'-0½" TPG.	61'-0"	"	"	"	1904	American Br Co	1904		112995	353 29	I & G N Underxing
U 932 1		Brushy Cr			182	Conc	1904			60'-0" DPG		"	"	E-63	1904	" " "	1904		46585	353 32	
					3	"	1904			84'-6" DPG		"	"	E-66	1904	" " "	1904		85023	353 31	
					4	"	1904			84'-6" DPG	230'-6"	"	"	"	1904	" " "	1904		85022	353 31	
U 932 6					182	"	1923			84'-6" DPG	85'-0"	"	E-50	E-75	1916	Wisconsin Br & I Co	1923		93980	352 204	AFE T-1566
U 948 6		Walnut Cr	Conc	1904	1	"	1904			45'-0⅛" TPG.		"	E-40	E-63	1904	American Br Co	1904		51410	353 34	
					2	"	1904			84'-6½" TPG.		"	"	E-62	1904	" " "	1904		122245	353 33	
								Conc	1904	45'-0⅛" TPG		"	"	E-63	1904	" " "	1904		51410	353 34	
8622		St Highway Underxing	Conc	1925				"	1925	37'-0" DPG		"	E-60		1925	" " "	1925		33827	353.	Conc deck. A.R.E. T-2012

From Job and Office

For Contractor and Engineer

stresses in the span in question are found, using the engine which it is proposed to operate over the bridge.

These sheets comprise the "Bridge Book" and are referred to when such information is required. The operating officials are supplied with copies and may refer to the various ratings when it is proposed to operate any engine over any division. When it is apparent that the engine may be operated at the usual speeds, it is so done. When it is questionable, the engineering department investigates. This record is also convenient when special loads are offered for movement and the effect on bridges must be known.

TABLE II—ENGINE RATINGS IN TERMS OF COOPER'S LOADING

CLASS	ENGINE NUMBERS	MAXIMUM ENG. WGT.	KIND.	14'-0" Trestle	20'-0" I-Beam	24'-0" I-Beam	30'-0" Girder	45'-0" Girder	60'-0" Girder	75'-0" Girder	82'-6" 70 11.8'	90'-0" Girder	100'-0" Girder	102'-1" 70 14.58	125'-0" 5@25'	150'-0" 6@25'	175'-0" 7@25	189'-0" 9@21'	200'-0" 8@25	222'-9" 9@24.75	Wheel Diagram
14 %	306-317	188000	Passenger.	E-17	E-20	E-20	E-20	E-21	E-23	E-23	E-23	E-23	E-23	E-23	E-24	E-24	E-24	E-24			
23 %	221-245	284000	Passenger.	E-27	E-30	E-30	E-30	E-32	E-33	E-34	E-35	E-35	E-34	E-34	E-34	E-34	E-34	E-35			
26 %	268-288	331000	Passenger.	E-35	E-36	E-36	E-37	E-36	E-37	E-37	E-38	E-38	E-37	E-37	E-37	E-37	E-38	E-38			
27 %	575-580	289600	Freight.	E-29	E-32	E-32	E-32	E-32	E-33	E-35	E-36	E-36	E-35	E-35	E-35	E-34	E-33	E-35			
29 %	5-38	257400	Switch.	E-43	E-43	E-43	E-41	E-36	E-36	E-36	E-36	E-36	E-36	E-36	E-36	E-35	E-35	E-34			
30 %	476-560	280200	Freight.	E-31	E-32	E-33	E-33	E-33	E-33	E-33	E-34	E-35	E-35	E-36	E-35	E-35	E-37	E-35			
30 %	427-450	315400	Freight.	E-32	E-32	E-32	E-33	E-34	E-35	E-35	E-37	E-37	E-37	E-37	E-37	E-38	E-38	E-38			
31 %	608-612 656-667	260000	Switch.	E-38	E-37	E-36	E-37	E-34	E-34	E-34	E-34	E-34	E-34	E-34	E-34	E-34	E-34	E-32	E-32	E-31	
32 %	357-366	386000	Passenger.	E-35	E-37	E-39	E-38	E-40	E-41	E-42	E-42	E-41	E-41	E-40	E-39	E-40	E-40	E-39	E-39	E-39	
38 %	367-376	402500	Passenger.	E-38	E-41	E-41	E-41	E-43	E-43	E-44	E-44	E-43	E-43	E-41	E-42	E-42	E-42	E-42	E-42	E-41	
41 %	399-413	474500	Passenger.	E-44	E-47	E-47	E-45	E-48	E-46	E-47	E-49	E-47	E-47	E-46	E-46	E-46	E-46	E-47	E-47	E-46	
44 %	616-655	382000	Freight	E-45	E-46	E-46	E-47	E-45	E-45	E-45	E-45	E-44	E-44	E-43	E-43	E-43	E-43	E-43	E-43	E-42	
51 %	39-68	372700	Switch.	E-55	E-55	E-54	E-52	E-51	E-46	E-46	E-49	E-45	E-45	E-45	E-43	E-44	E-44	E-44	E 44	E 43	
54 %	701-770	457000	Freight.	E-49	E-49	E-50	E-50	E-51	E-49	E-49	E 49	E-49	E-49	E 49	E 47	E 47	E-47	E-48	E-48	E-46	
61 %	801-920	517800	Freight	E-55	E-55	E-55	E-55	E-56	E-56	E-55	E-54	E-54	E-53	E-53	E-52	E-52	E-52	E-53	E 53	E 51	
60%	100-110	402800	Switch.	E-62	E-58	E-58	E-58	E-54	E-56	E-55	E-55	E-50	E-50	E-50	E-48	E-48	E-48	E-48	E-48	E-48	

Water Jets Consolidate Road Fills

By C. M. Hathaway

Engineer of Construction, Illinois State Division of Highways, Springfield, Ill.

Even with an adopted practice of completing heavy grading a year or two in advance of the paving, fills will settle. Sand or gravel will attain ultimate settlement almost immediately, but gumbo and clay do not settle at once, nor will they absorb enough water by capillary attraction or surface entrance to insure full settlement for several years. One of the most satisfactory methods of overcoming this difficulty is puddling by water jets. This was first tried two years ago, has been repeated in several instances since, and the results thus far obtained have been very satisfactory.

Little extra equipment is required. When the contractor has an ordinary 2-in. pipe line paralleling the road, there may be connected to it two or three hose lines for water leads. Each section of hose should be fitted with a 1-in. pipe long enough to extend to the bottom of the fill and fitted with a nozzle. In case a pipe line is not available, a pumping unit, capable of operating a 2-in. water line, may be used, preferably a movable unit.

The pipe is forced down by means of the jet until it reaches the bottom of the fill and the flow is then continued until the soil is saturated and the water overflows the hole. The first hole should be started at the center line. The second and third holes should be jetted about 10 ft. to the right and left of the first. A second row of holes should next be jetted at a point 15 to 20 ft. from the first and the work continued until the entire fill is covered. Frequently the holes will take a second or third application of water before ultimate saturation is reached.

In this jetting process it is always necessary to watch the sides of the fill to note whether or not water is escaping; this condition, however, is rarely encountered, due to the solid crust which is usually formed by weather action on the top and side slopes.

Within five to ten hours after jetting, cracks and subsequent settlement of the entire fill will be noted,

although a 10- to 12-in. surface crust often remains partly intact, the entire settlement taking place in the soil beneath. By careful level readings it has been observed that nearly all action takes place within the first 48 hours and that, after the first week, there is practically no settlement even over a period of several months.

It is frequently necessary to break up the surface crust with a rooter plow. It is also necessary to do the jetting a week or two ahead of the paving work, so that the fill may have time to dry out and permit truck hauling. Occasionally, a second jetting is made to insure final settlement; in fact, it might well be recommended until more accurate and definite results can be established. The cost is nominal, averaging approximately 10c. per square yard of surface area involved in the fill.

Rivet Spacing of Tension Members to Maintain Net Section

a, a_1, a_2 = Sum of gages minus thickness of L
y = Diam. rivet + $\frac{1}{8}$"

Table I
1 hole out

a	Min b				
	$\frac{5}{8}$" R	$\frac{3}{4}$" R	$\frac{7}{8}$" R	1" R	$1\frac{1}{8}$" R
3	1⅜	1½	1⅝	2	2⅛
3½	1⅜	1½	1⅝	2	2⅛
4	1⅜	1½	1⅝	2	2⅛
4½	1⅜	1½	1⅝	2	2⅛
5	1⅜	1½	1⅝	2	2⅛
5½	1⅜	1½	1⅝	2	2⅛
6	1⅜	1½	1⅝	2	2⅛
6½	1⅜	1½	1⅝	2	2⅛
7	1⅜	1½	1⅝	2	2⅛
7½	1⅜	1½	1⅝	2	2⅛
8	1⅜	1½	1⅝	2	2⅛

$b = \sqrt{ay + y^2}$

For 1 hole out, $b_1 = 2\sqrt{a_1 y + y^2}$

For 2 holes out, $b_1 = \sqrt{2a_1 y + y^2}$

*Note:—"b" must not be more than value given in Table I for given "a". If "b" is less than that given by line 1-3, check for breaking through 2 and 3 only. (deducting value of rivet No. 1 from total tension in L)

Table II

a_1	Min b_1 1 hole out					2 holes out					a_1
	$\frac{5}{8}$" R	$\frac{3}{4}$" R	$\frac{7}{8}$" R	1" R	$1\frac{1}{8}$" R	$\frac{5}{8}$" R	$\frac{3}{4}$" R	$\frac{7}{8}$" R	1" R	$1\frac{1}{8}$" R	
4½	3⅜	4⅛	4⅜	5⅛	2⅛	2⅜	3⅛	3⅜	4⅛		4½
5	4⅜	4⅛	4⅜	5⅛	2⅛	3⅛	3⅜	3⅝	5		5
5½	4⅜	4⅝	5⅛	5⅝	2⅛	3⅛	3⅜	3⅝	5⅛		5½
6	4⅜	4⅝	5⅛	5⅝	3⅛	3⅛	3⅜	3⅝	6		6
6½	4⅜	5⅛	5⅛	5⅝	3⅛	3⅛	3⅜	4	6⅛		6½
7	4⅜	5⅛	5⅛	6⅛	3⅛	3⅛	3⅜	4	6⅛		7
7½	4⅜	5⅛	5⅛	6⅛	3⅛	3⅛	4	4⅛	7		7½
8	5⅛	5⅛	6	6⅛	3⅛	3⅜	4⅛	4⅜	7		8
8½	5⅛	5⅛	6⅛	6⅛	3⅛	3⅜	4⅛	4⅜	8		8½
9	5⅛	5⅛	6⅛	6⅛	3⅛	3⅜	4⅛	4⅜	8		9
10	5⅛	6⅛	6⅛	7⅛	3⅛	4⅛	4⅜	4⅝	9		10
11	5⅛	6⅛	6⅛	7⅛	4⅛	4⅛	4⅜	4⅝	9		11

For 1 hole out, $a_2 + 2y = d + e$ (above zigzag line)
or $a_2 + y = c + e$

For 2 holes out: $a_2 + y = d + e$

Table III

a_2	Min b_2 1 hole out									2 holes out									a_2
	$\frac{5}{8}$" Riv.			$\frac{3}{4}$" Riv.			$\frac{7}{8}$" Riv.			1" Riv.			$\frac{5}{8}$" Riv.			$\frac{3}{4}$" Riv.			1" Riv.			
	c=2"	2½	3	2	2½	3	2	2½	3	2	2½	3	c=2"	2½	3	2	2½	3	2	2½	3	2	2½	3	
4½	2¼			2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	4½
5	2¼	2¼		2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	5
5½	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	5½
6	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	6
6½	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	6½
7	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	7
7½	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	7½
8	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	8
8½	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	8½
9	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	9
10	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	10
11	2¼	2¼	2¼	2⅛	2¼	2⅜	2⅛	2¼	2⅜	2⅛	2¼	2⅜	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	1⅝	11

THE tables herewith reproduced are submitted by F. C. Whitney, structural engineer with William B. Ittner, Inc., architects and engineers, St. Louis, Mo. Mr. Whitney says: "These tables elaborate on the well-known table in Carnegie and the same notation is used to facilitate comparison. Table II is handy in checking shop drawings, as rivet 2 is usually detailed off the line 1-3, and may govern, although 'b' is satisfactory. While it may be usual practice to take two holes out of angles of 6 in. and over, a worth-while saving may be effected by making 'one hole out' on the stress diagram and then watching the shop details to see that the warning is heeded."

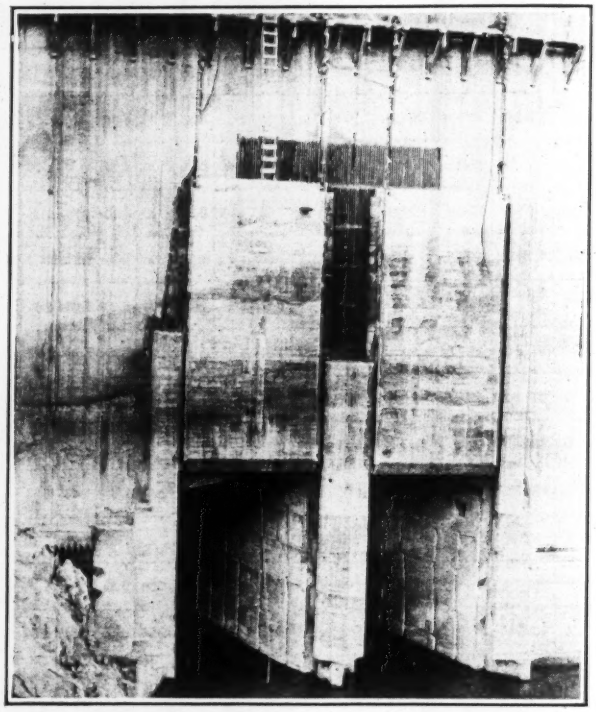
From Job and Office

Hints that Cut Cost and Time

Exchequer Dam Closure to be Made by Timber-and-Concrete Gates

CLOSURE of the channel through Exchequer dam which is being built for irrigation storage on the Merced River in California will be effected by two gates of combination timber-and-concrete construction which are hung by cables on the upstream face of the dam, awaiting the decision to begin storage. Construction of this dam was described in *Engineering News-Record*, May 28, 1925, p. 880.

During construction the river has been passed through the dam by means of two openings, side by side, which it is now proposed to close by two gates each 16 ft. wide by 30 ft. high. The gates were built up on the face of the dam just above these openings where they are hung by cables from near the top of the dam.



GATES AWAITING CLOSURE OF EXCHEQUER DAM

Each cable passes over a sheave on the gate and when the time for closure comes if the water is at low stage the gate will be lowered to position with tackle. If at flood stage the cables supporting the gates will be simultaneously cut by oxyacetylene torches so the gates will drop with force enough to reach the seat despite the flow of water through the opening. Each gate weighs 75 tons.

The gates consist of a backing of 12x30-in. timbers laid flat and faced with a reinforced-concrete slab, 18 in. thick, extending the full height of the gate. The

From Job and Office

For Contractor and Engineer

timbers have a bearing of approximately 12 in. on each side of the opening and as they descend will be held in place against the face of the dam by reinforced-concrete guides extending the full height of the flood channel opening and about half way up the gate in its raised position.

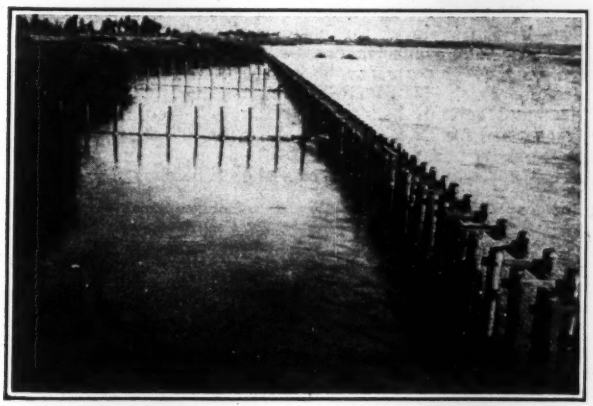
When construction of these gates started, the lowest timber was put in place first and supported with tackle while the next one was being bolted to it. The two channels shown in the accompanying illustration were then put in place and drifted to the two bottom timbers. A bracket of reinforced concrete having previously been constructed on the upstream face of the dam directly over the center of each gate and near the top of the dam, a 1½-in. cable approximately 500 ft. long was hung over this bracket and fastened around a 12-in. sheave at the top of the channels on each side of the gates. The remaining 12x30-in. timbers were then put in place, each being drifted to the one last placed with 1x12-in. drift pins driven with an air hammer.

Forms were then built for the concrete on the face of the timbers and an initial pour 2 ft. in depth was made. The remaining concrete was poured in 6-ft. lifts. Forms were held in place with No. 8 wire run through eye drift pins sunk in the timbers.

Contract for this work is held by Bent Bros., Inc., to whose superintendent, M. H. Slocum, *Engineering News-Record* is indebted for the foregoing.

Piling and Wire Fencing Protects Stream Banks near Bridges

EFFECTIVE protection of stream banks near the abutments of highway bridges has been secured by the California State Highway Commission by the use of piling driven as shown in the accompanying picture.

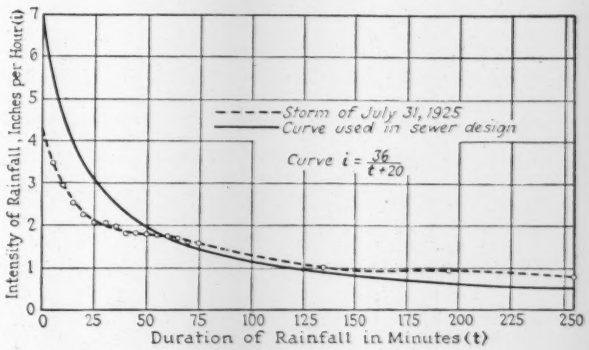


BANK PROTECTION AT KING CITY BRIDGE, SALINAS RIVER, CALIFORNIA

The double line of piling or jetty parallels, in general, the toe of the bank, and the single pile cross jetties are run from the jetty to the bank at 200-ft. intervals. Heavy barbed wire is fastened to the piles on a 6-in. spacing.

The area thus inclosed between bank and jetties is planted to willows and as these grow up they very materially aid in holding the soil and preventing destructive eddies along the slope of the bank. This type of bank protection has been used in California for several years and has been found very satisfactory particularly where the formation is sandy loam that is easily washed away during floods.

Relation Between Time and Intensity of Rainfall



DETROIT and the vicinity were visited by a heavy rain July 31, 1925, which lasted more than 2 hours. It is reported that only once before in the 50-odd years of life of the U. S. Weather Bureau has there been a storm lasting more than 120 min. The record of the July storm has been plotted, as shown above, together with the intensity curve that is used by the Department of Public Works in the design of sewers. It is interesting to note the practical identity of the theoretical and actual heavy precipitation. The record of the storm was made by L. G. Lenhardt, assistant engineer of land tunnels of the Detroit Department of Water Supply.

Regarding Mr. Hirschthal's Article

In the article written by M. Hirschthal in *Engineering News-Record* Feb. 25, p. 332, there was an error in the paragraph on personnel. It should have read, "The writer selected the type and the design of this structure."

Job and Office Notes

"Use of Bituminous Precast Filler to provide expansion in bridge rails has always had the disadvantage," writes F. M. Balsley, construction engineer of the Wisconsin Highway Commission, "that in cases of extreme expansion the filler squeezes out from between the faces in contact and fails to return to place when the rails contract, leaving an opening between the ends of the rails. The projecting filler creates an unsightly appearance on ornamental railings. We have been experimenting with the use of a filler made of cork such as is used to insulate refrigerators and dwellings. This material is cut into sections a half-inch in thickness, and shaped to the same dimensions as the ends of the rails. This type of filler has been used on only one bridge this past season, and we are not in a position at this time to say how efficient it will be. The cost is 50c. each delivered on the work. Bituminous fillers work out very nicely in floors where traffic pounds them down, as they tend to rise during the heated season. Cork would be altogether too brittle for this purpose but it is our opinion that it will work out very nicely in railing work, for the reason that it will compress under expansion and resume its original position when the rails contract."

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Waterway Enthusiast Comes Back

Sir—The editorial which appeared in your issue of Feb. 5 under the heading "Will The Inland Waterway Come Back?" is remarkable both for what it does and does not say.

If, as you state, the fact "that vehicles move more easily through water than on land" is "true, though unimportant," how does it happen that the largest cities, the densest population, the greatest development of commerce and industry are still to be found along the waterways of the world—just as they were before railways were heard of?

You say: "There is still the incontrovertible fact that no inland waterway in this country, since railway transportation became effective, has ever even approached paying for its real cost unless one wishes to claim a large, and altogether unprovable, benefit through lowered competitive rail rates."

Did you ever hear of the Monongahela River? Up to June 30, 1925, the government had spent—for the purchase of works built by a private corporation and for the construction of additional locks and dams—a total of $10,882,318.83. The annual interest on that amount, at four per cent, is $435,292. Add to this the cost of maintenance and operation for the fiscal year 1925 and we get $1,253,261. In the calendar year 1924, the freight carried on the river was 21,878,815 tons, of which 21,382,617 tons was coal.

The actual cost of carrying this coal to Pittsburgh was about 14 cents per ton, and the $1,253,261 equals 5.72 cents, making a total cost, including cost of maintenance and interest on cost of construction, of a little less than 20 cents per ton, as compared to a rate of 88 cents per ton by rail. Leaving out of consideration the "altogether unprovable" question of whether or not this rail rate is lower than it otherwise would be, because of river competition, and disregarding the nearly 500,000 tons of other traffic which was carried, this direct saving of 68 cents per ton on the coal carried in one year amounts to $14,540,179, or $3,658,000 more than the total cost of construction.

The total amount expended for maintenance and operation up to June 30, 1925, was $13,343,376, but the direct saving on traffic carried in 1923 amounted to more than that, so the saving in two years has paid back several millions of dollars more than the total amount spent upon the river for all purposes. More than 500,000,000 tons of coal have been carried on the Monongahela since the first locks were opened in 1844. More than 380,000,000 tons of traffic have been carried since 1890. The value of the traffic carried since 1912 is more than $1,000,000,000. Perhaps some of your "transportation experts and engineers who have divorced themselves from historical delusions and psychological disturbances" can calculate the grand total of savings on the whole vast volume of traffic which has been carried on the Monongahela.

Even that would not constitute a complete appraisal of the benefits produced by the improvement of this little river. The manager of one large plant once said that, in order to receive all his coal by rail, one-third of the whole plant would have to be turned into a railroad yard. At a time when one of the old dams was found to be unsafe, the late William Whigham, vice-president and general manager of the Carnegie Steel Company, said to me: "If No. 6 goes out, two-thirds of all the iron and steel production in Pittsburgh will have to stop until it is repaired."

Without the improvement of the Monongahela, the Pittsburgh of today would have been an absolute impossibility.

I agree with you as to the vital importance of terminals and that the motor truck has greatly widened the economic field of waterways, but your editorial never even mentions that for which the "psychopathic enthusiasts" of the country have been working for many years, namely, the complete co-ordination of rail and water transportation. Few waterways can develop a large and profitable business if they are confined solely to traffic which originates on and is destined to points upon their banks.

And, it is worth while to add, few railways could develop a large and profitable business if confined solely to traffic originating on and destined to points on their own lines. Of the 2,331,291,297 tons of freight handled by class I railroads in 1924, only 1,188,156,661 tons are listed as "originating on line," the remaining 1,213,134,636 tons being "received from connections."

"Psycyhopathic enthusiasts" are chiefly responsible for the passage of many laws for the benefit of waterways, from the original Interstate Commerce Act to Section 500 of the Transportation Act of 1920, which declares the policy of Congress to "foster and maintain in full vigor both rail and water transportation." The Interstate Commerce Commission has been given power to order the connecting of "the tracks of a carrier by rail with the dock of a carrier by water"; to arrange, and if necessary compel, the formation of through rail-and-water routes and to establish joint or proportional rates for the carriage of traffic thereon.

Our study of history has shown us that, after population and traffic have reached a certain degree of density, further progress is impossible without the use of all available forms of transportation. So, while others are working for the railways and the highways, we are working for the improvement of every waterway and harbor in the United States—provided such improvement is found to be justified after surveys and examinations have been made by competent engineers.

In conclusion, let me call your attention to the fact that the overwhelming majority of those whom you term "psychopathic enthusiasts" are not in lunatic asylums or institutions for the feeble minded, but are carrying on the business of the country; that they pay the taxes which support the government; that their votes elect presidents, senators and members of congress; that it is their traffic which is being carried and their money that pays for carrying it, no matter whether it goes by road, river or rail; and that the inland waterways are coming back because the people need them in their business—the carping of captious critics and the sneers of supercilious scribes to the contrary notwithstanding.

S. A. THOMPSON,
Secretary, National Rivers and Harbors Congress.

Washington, D.C.,
Feb. 18, 1926.

Corrected Table, Pit River Power Plants

Sir—In the table at the bottom of p. 144 in the article, "Volcanic Formations Govern Design in Pit River 3 Hydro Development," in your Jan. 28 issue, there is a typographical omission which is somewhat misleading. The last or right hand column headed "All Plants" should have been marked "Future Developments, All Plants." If this correction is made, and an additional column is included for "All Plants," the table would read as shown below.

DATA ON PIT RIVER HYDRO-ELECTRIC DEVELOPMENTS

Head	Four Existing Plants	Future Plants	All Plants
Total on Pit River	769	1,267	2,036
Total on Hat Creek	418.1	.....	418.1
Effect on Pit River	702	1,158.5	1,860.5
Effect on Hat Creek	393.5	.....	393.5
Installation, kva.	176,000	306,000	482,000
Output			
Peak, kw.	136,400	241,700	378,100
Million, kw.-hr. annually	812	1,583.1	2,395.1

I am writing you in this connection because there has been some question by readers of the article as to the correct interpretation of this particular column in the table.

WALTER DREYER,
Assistant Engineer, Pacific Gas & Electric Co.

San Francisco, Calif.
Feb. 18, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Hoover Favors Inland Waterway Development

In Chicago Speech Outlines Nation-Wide System and Urges Great Lakes Control

Speaking before the John Ericsson Republican League of Illinois, at Chicago on March 9, Secretary of Commerce Hoover elaborated his earlier recommendations for a co-ordinated national system of inland waterways and urged that the Middle West stop trying to settle the Great Lakes-Chicago Drainage Canal controversy by lawyers and leave the solution to engineers.

In part he said:

"The necessarily large advance in our railroad rates as a result of realignment of values from the war serves to put a row of tollgates around the Middle West, which together with the completion of the Panama Canal and with ocean rates maintained at the low pre-war basis all combine to distort the economic setting of this whole section.

"I believe most of those who have examined the question agree that if we were able to run ocean shipping into the Lakes and if we had the Mississippi waterways fully modernized we could show savings of from 6 to 11 cents per bushel in transport from different parts of the Mid-West, or about the amount of rail rate increases.

A Connected System

"We must visualize our inland waterways as a great connected transportation system, rather than as disconnected lake, canal and river projects. Our waterways naturally comprise two great inland systems—the Mississippi system of modern barge lines and the Great Lakes system of ocean steamers, both reaching to the sea and to Chicago.

"If we examine our possibilities in this vision we find that the rivers of the Missisippi drainage between the Alleghenies and the Great Plains are disposed topographically in such a fashion that by deepening them we could project a 9,000 mile consolidated system through which 20 states could find cheaper transportation for their import and export raw materials and much advantage in interior distribution.

"That system would comprise an east-west trunk line from Pittsburgh through St. Louis to Kansas City, a distance of 1,600 miles, along the Ohio, Mississippi and Missouri, and it would also comprise a north-south trunk waterway from Chicago to New Orleans.

"I hope that the battle for the construction of the great Mississippi system will be won at this session of Congress. I therefore believe that we are in sight of the nine-foot channel from

(*Continued on p. 424*)

Engineering Fifty Years Ago

From *Engineering News*, March, 1876

THE contractor for constructing the new Water-Works Tunnel at Cleveland, commenced sinking the east shaft, on Wednesday, March 8th. He now has the machinery all ready and will put the shaft down at the rate of about ten feet per day.

St. Louis Mayor Makes Charges Against E. E. Wall

Engineers, business men and the daily press of St. Louis have made vigorous protests against the charges preferred by Mayor Miller on March 3 against E. E. Wall, director of public utilities, following Mr. Wall's refusal either to dismiss the chief of the electrical bureau or else resign. This alternative was accompanied by a threat to remove Mr. Wall from office in case he refused to comply with the mayor's demands. Charges and a hearing before the mayor are required by the city charter in such cases as this one. Mr. Wall having been given only 43 hours to prepare for the hearing, his counsel sought a court stay on the ground of insufficient time. Pending a ruling by the court, the mayor extended the time for the hearing from March 5 to March 10.

Already the mayor has offered to compromise by restoring Mr. Wall to the position of water commissioner which he had held for years when Mayor Miller advanced him to be director of utilities, in which department the water-works is. The joint council of the Associated Engineering Societies of St. Louis, on March 4, adopted a resolution supporting Mr. Wall, and the daily papers of St. Louis are also backing Mr. Wall. The consensus of opinion among Mr. Wall's supporters is that Mayor Miller will face a recall election if he does not back down.

Pass Muscle Shoals Leasing Bill

The Muscle Shoals concurrent resolution, empowering a congressional commission to receive bids for the leasing of the government property, was passed by the Senate on March 8. Amendments to the House resolution included authorization of equitable distribution of power to communities to which the power can be transported, and a provision that fertilizer production be the primary object of any lease. Failure of the House to accept that and another Senate amendment calling for a report from the proposed congressional commission on its findings by April 26, may mean the postponement of disposition of the Shoals property until the December session, at least.

Gov. Smith Would Make Ship Channel of Barge Canal

Urges Transfer to Federal Government on N. Y. Legislature—Greene Cites Huge Yearly Loss

Transfer of the New York State Barge Canal to the federal government for conversion into a Great Lakes-to-Hudson ship channel was recommended by Governor Smith in a special message to the N. Y. State Legislature March 8. The recommendation was accompanied by a report from Col. Frederick Stuart Greene, superintendent of public works, which included figures representing the loss which the Barge Canal is sustaining each year.

Governor Smith urged the passage of appropriate legislation to allow the existing Barge Canal Survey Commission to negotiate with federal officials for the transfer of a water route which, though he said was a decidedly burdensome tax on the public purse, yet is one which should be conserved for larger and more extensive uses.

Colonel Greene reported that during 1925 the canal carried but 2,344,013 of its 20,000,000 tons capacity, and that it cost above receipts, during the same period, $10,573,626. He asserted that the average rail rate from Buffalo to New York—the longest haul of which the Barge Canal is capable—was $3.70 per ton, and that each ton of freight floated on the canal cost the state $4.51, regardless of the length of haul. Colonel Greene stated that he was not convinced that the existence of the Barge Canal had saved shippers $50,000,000 in "depressed" rail rates. He said also that even were that the case an annual deficit of $10,500,000 was rather a heavy club to hold over the railroads to keep the rates "depressed."

River and Harbor Board Hears All-American Canal Plan

Proponents of a project for a Great Lakes-to-Hudson deep waterway were heard Tuesday when hearings on an adverse report of a War Department survey board began before the Board of Engineers for Rivers and Harbors. While no information has been given to the press as to the contents of the adverse report, it is understood that the engineers found that prospective traffic would not be commensurate with the cost of a 21-ft. or 25 ft. channel.

Col. Frederick Stuart Greene, superintendent of public works of New York, followed Chairman Dempsey of the House Rivers and Harbors Committee in support of the canal.

Those opposed to the construction of the proposed deeper waterway will be heard by the Rivers and Harbors Board on March 15, after which it is probable deliberations will follow on the military aspects before any recommendation is made.

Diplomatic Exchanges on Chicago Diversion

State Department Makes Public Latest Canadian-U. S. Correspondence On Drainage Canal

The U. S. Department of State with the approval of the British Embassy on Feb. 24 made public the more recent correspondence between the two governments in regard to the diversion of water from Lake Michigan to the Sanitary District of Chicago. This publication is supplementary to publication of correspondence made about a year ago and reported in *Engineering News-Record*, April 30, 1925, p. 721.

The correspondence goes back to April 2, 1924, and the early parts of it relate mainly to a request by the Dominion of Canada that it be allowed a representative at the War Department hearings on the Lakes-to-Gulf waterway and on the then proposed order of the Secretary of War in the matter of the Chicago diversion. This permission was granted. Throughout the correspondence the British ambassador renewed his plea that the United States Government give some reassuring message to the people of Canada that favorable progress is being made in the matter of protecting the Canadian interests which would possibly be damaged by continued diversion of water by Chicago. The State Department refused to make any such statement until the Supreme Court decision (subsequently rendered in January, 1925) cleared up the legal phases of the controversy.

British Ambassador's Note

Under date of Feb. 24, 1925, after the War Department's hearing, the British Ambassador wrote as follows: "The Dominion Government now desire me to state that while they would not wish to oppose any interim measure which may be necessary to protect the health of the inhabitants of the city of Chicago, they feel compelled to reiterate the protest they have already made against the abstraction of water from the St. Lawrence Basin and, in order that there may be no misunderstanding, I desire to take this opportunity of making it clear that the Government of Canada do not surrender any claims that might be put forward for consequential losses already suffered or which may possibly be suffered in the future on this account. The Dominion Government are of the opinion that it is impossible to lose sight of the fact that the effect of the present increase in permitted diversion of water will be to postpone the relief for which the navigation and other interests injuriously affected by the attitude of the Chicago Sanitary District have been waiting already too long and which, subject only to the paramount necessity of safeguarding public health, these interests are now entitled to receive."

On March 3, 1925, a permit was issued by the Secretary of War to the Sanitary District of Chicago authorizing the temporary withdrawal from Lake Michigan of 8,500 sec.ft. of water until Dec. 31, 1929, subject to certain specific conditions which are set forth in the permit and which were reported in *Engineering News-Record* March 12, 1925, p. 448. Under date of May 7 the British Government asked the United States Government precisely the extent to which the new permit "will modify the actual conditions which obtained during the year immediately preceding the 3rd of March, 1925," and asked some questions regarding the amount of flow during the past year and the degree to which this flow would be cut down by the new permit. Under date of June 2, the British Government further reported to the American Government a query brought before the Canadian House of Commons which intimated that the War Department permit allowed not only 8,500 sec.ft. through the canal as drainage, but also the 1,300 sec.ft. represented by the turning of the course of the Chicago River and 1,200 sec.ft. for the purposes of water supply.

Under date of June 15, the United States Government gave the statistical figures asked for and stated that the 8,500 sec.ft. was to be measured at Lockport and did not include 1,200 sec.ft. used by the city of Chicago for domestic water supply. The State Department said that the order was to the Chicago Drainage District which was not concerned with Chicago's domestic water supply, and therefore no restriction on that water supply was made in the permit to the district. Under date of Sept. 15 the British Government reiterated its belief that possibly the order, in addition to the 9,700 sec.ft., noted as permitted in the latest State Department letter, included a flow of 1,300 sec.ft., the intercepted flows of the Chicago and Little Calumet Rivers which normally would have flowed into the Lake's basin but which are now passing down the drainage canal into the Mississippi Basin.

Under date of Nov. 24, Secretary of State Kellogg replied to this letter by saying that the Chicago and Calumet River supplies were not included in the permit and that "the gross flow at Lockport will not exceed an average of 9,700 sec.ft. and by the time the permit of March 3, 1925, has expired, the gross flow may be reduced to 8,000 sec.ft. and probably to 6,700 sec.ft. The sewage treatment program of the Sanitary District has been arranged so as to make it possible to effect a reduction to gross flow of 4,167 sec.ft. by the year 1925." He further stated that a British Government suggestion that the April 29, 1925, order of the War Department, authorizing the dredging of the Little Calumet River, might add to the flow, was not founded on fact, because this later permit specifically restricted the operations to those which would not permit an increase of flow over that permitted in the order of March 3. Secretary Kellogg said that the practical enforcement of the limitation placed upon the diversion will be carried out at Lockport. "Measurements taken there will determine the gross diversion, sanitary and domestic, and as accurate information is available in regard to the amount of water pumped by the city of Chicago for domestic purposes, the sanitary diversion may be computed by subtracting the domestic diversion from the gross flow at Lockport."

Detroit Approves Large Sewer Program

Budget Provides $12,000,000—City To Start Day Labor Plan to Get Costs of Public Work

Following out the recommendation of the city engineer, the mayor and council of the city of Detroit have approved an item of $12,000,000 in the 1926-27 budget for the construction of sewers and $2,000,000 is to be made available immediately for sewer relief work. Bids are being asked on two sections of sewers, one 2,456 ft. long and ranging in size from 3-ft. cylinder to 4½-ft. cylinder, and the other including 2,174 ft. of 10-ft. cylinder.

Detailed plans are being completed and bids will be asked soon on the Mill Road sewer which will be constructed in tunnel in seven sections each approximately one mile long. Five sections will be 10-ft. cylinder, one section 12-ft. 9-in., and one section 13½-ft. This sewer will extend from the Rouge river to Puritan Ave. The dredging of Fox Creek and a part of the Jefferson Ave. interceptor are also to be included in the early projects. The Jefferson Ave. interceptor is the first step towards the proposed disposal system and the section planned will be an 11-ft. cylinder approximately 7,500 ft. long.

At the request of the commissioner of public works, the council has voted to include an item in the budget, providing the department with a fund of $500,000, $400,000 of which is to be used as a revolving fund to permit the city to bid on pavement construction in competition with private contractors, and $100,000 to be used in extending the department's activities in sewer work.

The cost of an additional asphalt plant to be located in the northwest section of the city, and a new material yard, both of which are considered essential if the city is to compete successfully with private contractors, is to be determined. It is estimated that the asphalt plant will cost approximately $240,000.

Contractors Oppose Day Labor

The city's action, backed by Mayor John W. Smith, was opposed by the Michigan Municipal Contractor's Association, an association of sewer contractors.

One of the first points to be taken up by the department is the setting up of a cost accounting system on paving and sewer construction. A construction division is to be set up within the Department of Public Works, to have charge of all activities relating to the building of new sewers and new pavements. It will be possible to equip the new division for its sewer construction work by turning over to it equipment now owned by the department and used for such work. No equipment is available for paving activities and it will therefore be necessary to acquire equipment sufficient for two paving construction units. The overhead of the new division is to be proportioned to the sewer and paving funds.

Mayor Smith stated that the city of Detroit has no desire to enter into private business but he deems it the duty of the city to ascertain by this means the cost involved in public work.

Would Eliminate Surety Bonds in N. Y. Building Contracts

The requirement that the contractor furnish a bond is recommended expunged from the Public Buildings Laws of New York State by Sullivan W. Jones, state architect, in his report as special commissioner to inquire into surety bonding practices in connection with public building contracts. The report, just issued, contains a severe criticism of bonding practices and recommends a number of changes in present laws to permit the state to execute contracts without requiring bond. A full abstract of the report and comment on its findings and recommendations will appear in next week's issue.

Bonds for New York-New Jersey Bridges Issued

Bonds amounting to $14,000,000, bearing 4½ per cent interest have been issued by the Port of New York Authority for the construction of two bridges across Arthur Kill from Perth Amboy to Tottenville and Elizabeth to Howland Hook. According to Julian A. Gregory, chairman of the Port Authority, construction will begin at once.

These are the first spans planned by this body to connect New York and New Jersey in its comprehensive scheme to develop the New York harbor area. Design and estimates for another bridge to cross the Hudson River are being prepared. The minimum span of such a bridge is estimated to be 3,500 ft. between piers.

The bonds for the Arthur Kill bridges were awarded on a bid of 97.25 to a banking group consisting of the National City Co., Brown Bros. & Co., Harris, Forbes & Co., Kissel, Kinnicutt & Co., and White Co., and are now being offered to the public at par value. These bonds are of a unique character in that they are issued by a public corporation created by compact between the states of New York and New Jersey with the consent of Congress. They are secured by a first lien upon revenues and tolls arising from the use of the two bridges but carry no governmental guarantee.

Tolls Agreement Prepared for Philadelphia Camden Bridge

At the meeting of the Delaware River Bridge Joint Commission in Philadelphia on Friday March 5, a tolls agreement between Pennsylvania and New Jersey was approved by the commission, thus bringing to a final conclusion the impasse between the states that has made impossible the placing under contract of the work required to complete the bridge. At the same meeting four contracts were awarded covering all work required to open the roadway to traffic on July 4, 1926.

The tolls agreement provides for a basic charge of 25c. per passenger automobile. Tolls to be levied on motor trucks and on wagons will be determined upon later and the charges to be made for busses will be made the subject of special agreements between the utility companies and the commission. Estimates of the probable traffic that will be carried by the bridge indicate that with the toll rate as thus fixed, the entire cost of the structure will be paid within seventeen to twenty years.

The four construction contracts awarded are as follows: Contract No. 24, for metalwork, including lamp standards, hand railings, grating, etc., to Ford & Kendig Co. for $622,000; Contract No. 25, for electrical equipment, to W. Pangborne & Co. for $209,626; Contract No. 26, for wrapping the cables with serving wire, to Keystone State Corporation (a subsidiary company of the Keystone State Construction Co.), for $139,000; and Contract No. 27, for grading, paving and other work for the Camden Approach from Fifth St. to Seventh St., to the O'Neill Co., for $150,460.20.

In addition to these construction contracts, a contract was awarded to the Richard Kelley Co. for the removal of earth from a portion of the Philadelphia approach at a cost of $15,300.

Arkansas Cities Unite to Seek Bond Issue Authorization

Officials of eight Arkansas cities have formed the Arkansas Municipal League for the principal purpose of securing legislative authorization for cities of the first and second class to issue public improvement bonds. All new municipal improvements are now secured, due to an old constitutional barrier against public bond issues, by the formation of improvement districts and the assessment of cost by the district upon the property benefited.

The Arkansas Municipal League will supervise the circulation of petitions which, it is hoped, will contain the 12,600 signatures necessary to put the proposed constitutional amendment before the electorate at the state election this fall.

Mayor A. D. Murphy, of El Dorado, is the president of the Arkansas Municipal League. The petitions, bearing not less than 12,600 signatures properly proportioned among counties of the state, must be presented to the secretary of state before June 5.

New Metcalf & Eddy Firm Is Established

By reason of the death of Leonard Metcalf, the partnership of Metcalf & Eddy has been dissolved but a new partnership by the same name has been formed by the surviving partners with the addition of Harrison P. Eddy, Jr. The firm of Metcalf & Eddy will continue the professional practice of engineering with the following in the firm: Harrison P. Eddy, Almon L. Fales, John P. Wentworth, Charles W. Sherman, Frank A. Marston and Harrison P. Eddy, Jr. The firm's address is 14 Beacon St., Boston, Mass.

Mr. Metcalf died Jan. 29, after a long illness, and a biography of him appeared in *Engineering News-Record*, Feb. 4, p. 210. Succeeding issues carried appreciations of Mr. Metcalf's personal and professional life by brother members of the profession.

Am. Soc. C. E. Opposes Bonding Professional Engineers

Recent resolutions of the Board of Direction of the American Society of Civil Engineers read as follows:

"WHEREAS: It has come to the notice of the Board of Direction of the American Society of Civil Engineers that the giving of bonds to insure the faithful performance of professional services has been required at various times and places in this country of members of the engineering profession, more particularly by municipalities presumably under some general requirement that all contracts entered into by such municipalities must be fortified with a performance bond.

"WHEREAS: The dignity and the standing of the engineering profession would be lowered by a toleration of this practice which is out of harmony with the treatment of members of other professions.

"Therefore be it resolved: That the American Society of Civil Engineers through its Board of Direction protests most vigorously against the placing of professional engineers under bond for the faithful rendering of professional service and urges its members to make their propositions and agreements to render professional service in such form that wherever practicable bonding will be avoided."

Also—

"WHEREAS persons untrained in technical matters are frequently appointed to fill public positions and offices whose incumbents should have knowledge and experience along engineering lines, and

"WHEREAS the practice is already well established in regard to other professions to recognize special qualifications, as, when a member of the legal profession is called upon to fill an office or position requiring a knowledge of law, or when a member of the medical profession is called to an office requiring medical training; therefore be it

"Resolved by the Board of Direction of the American Society of Civil Engineers, that public positions and offices whose incumbents are charged with duties requiring engineering or other technical training should be filled with properly qualified persons, and that whenever positions or offices are to be filled which are concerned with the administration of engineering matters every reasonable effort should be made to fill the same with competent members of the engineering profession."

Construction Division Association Meets in Washington

At its recent meeting in Washington, D. C., the Construction Division Association elected the following officers: President, Colonel Edward B. Ellicott, consulting engineer, Chicago, Ill.; vice-president, William O. Washburn, of the American Hoist & Derrick Co., St. Paul, Minn.; secretary, Major John A. Nyden, Chicago; and treasurer, Major T. Frank Quilty, of the Quilty Construction Co., Chicago, Ill. Next year's meeting of this association of World War veterans will be held in Chicago.

New Charter for Louisville, Ky., Again Proposed

There has been reintroduced in the Kentucky Legislature a bill for a new charter for Louisville which passed the last session of the Legislature and was vetoed by the former Governor. The bill provides for 12 aldermen as a substitute for the present bi-cameral council, and for six single-head executive departments — works, safety, finance, welfare, health, and law. Appointments would be made by the mayor, subject to the approval of the Board of Aldermen. Appointees would be chosen on the basis of their qualifications for the work to be undertaken, and would hold office indefinitely, subject to removal by the mayor for cause.

County Road Superintendents in Illinois Want Gas Tax

At the Feb. 24 meeting of the Illinois State Association of County Superintendents of Highways, the organization went on record favoring a gasoline tax, the major portion of which would be allocated to the counties for state-aid or secondary roads and to cities and villages for arterial streets. The association urged adoption of the metric system, designation of the county superintendent of highways as officer to approve subdivision platting outside of corporate limits, publication of *Illinois Highways* by the Department of Public Works and provision by Congress for the full amount of money named in the Temple Bill for topographic surveys.

Bridge and Tunnel Costs Further Increased

Further increase of cost of the Delaware River bridge and the Hudson River tunnel has just been made known by the request of the Interstate Bridge and Tunnel Commission to the New Jersey legislature for an additional $2,500,000 appropriation. The state's original appropriation for the two projects was $28,000,000. Two years ago the need for more money led to a second state referendum authorizing an issue of $8,000,000 of bonds, making the state's total $36,000,000. The present request for $2,500,000 which is expected to allow for completion of both projects, brings the amount to $38,500,000. This includes about $15,500,000 for the Philadelphia bridge, out of a total cost of about $37,000,000, and about $22,500,000 for the tunnel, out of a total cost of about $45,000,000. The original estimates for the two undertakings, on which construction was authorized and begun, approximated $28,000,000 for the bridge and $28,500,000 for the tunnel, including engineering and contingencies. The one-third increase in the bridge cost is almost wholly represented by increased costs of real estate required for the bridge and approaches. In the case of the tunnel, where the increase of cost amounts to about 60 per cent, part is due to increased real estate takings and part of it to excess of construction costs over the estimate.

Hoover Favors Inland Waterways

(*Concluded from p. 421*)

Chicago to the Gulf. But great as this accomplishment will be, the unlocking of the Great Lakes System to the sea is of first importance. Transportation on the Great Lakes involves two great problems—a deep channel to the sea, and a stabilization of the levels of the Lakes. At my suggestion, two years ago we entered upon an agreement with the Canadian Government for a joint and conclusive engineering investigation of the St. Lawrence route. Our engineers are also making a comprehensive engineering review of the shipway route across New York State. These investigations will be completed within a few months. We already know that 25-ft. canals can be built upon both routes but until we have the complete engineering data whereby we can compare the cost of construction and the advantages in operation of the two routes, it is useless to enter upon debate as to their comparative merits. When we have the facts and conclusions in hand, we can then hammer them out on the anvil of debate.

"But in the meantime there is another series of problems connected with the Great Lakes System which demands our attention. During the last seven years the levels of our lakes have been steadily falling. A drop of two to three feet in water levels has greatly impaired the traffic for the depth in our lake harbors and connecting canals have been decreased by just that amount. It is computed that the loss in transportation on the Lakes during the past season alone amounted to upwards of nineteen million dollars because of its shrunken depths. The United States Engineers report that something less than one-sixth of this fall has been due to diversion at Chicago and five sixths to the climatic cycle.

Not A Partisan Discussion

"I do not propose to enter into a partisan discussion of these questions, although it may be safe to hazard that Chicago is not to blame for the climatic cycle, moreover it is plain that she must have some water from the lakes. Quarrels concerning water quickly get from the realm of engineering to the realm of emotion. The real question is to hold more water in the lakes. Lawyers and courts cannot hold it there —but the engineers can. Litigation produces feeling but not water. I have observed throughout the whole country that for some reason quarrels over water questions create more emotion than even land questions. And I ask all the lake region to consider that before the controversies go further we had better spend our money on cement and steel rather than on the lawyers. We should be as much concerned with the five-sixths of the drop in levels as we are with the one-sixth which it is proposed to remedy in the courts.

"I am in hopes that we may be able to enter upon friendly discussion with our Canadian friends upon these many problems of the Lakes. I believe that upon examination by reasonable men bent upon solution, it will be found that there is complete mutuality of interest between our two countries in these matters, and that we shall be able to propose solutions of cement and steel which will protect all the cities and interests upon the Lakes whether in Canada or the United States, including Chicago—and we believe it can be done by engineers much more effectively than by the courts or international dispute."

Congress Authorizes State Toll Bridge

Arkansas has been granted permission to build a toll bridge across the Red River near Fulton, by act of Congress approved Feb. 4. The act authorizes the State Highway Commission to fix the toll rates so as to produce sufficient revenue for maintenance and refunding, but requires the bridge to be operated as a free bridge when refunding is complete or in any event after 25 years.

Storage and Power Developments on the Gatineau River

A hydro-electric plant is being constructed for the Canadian International Paper Co. on the Gatineau River at Chelsea about ten miles north of Ottawa, Ont. The dam is to be 100 ft. high and the plant will develop 24,000 hp. It is proposed to build another plant of the same size immediately below this one.

In order to regulate the flow of the river to 8,000 sec.-ft. the province of Quebec has recently awarded a contract for the erection of a storage dam 25 miles north of Maniwaki, Que. This dam will be built across the Gatineau River and will control a reservoir with a capacity of 80 billion cu.ft. According to Mr. Oliver Lefebvre, chief engineer of the Quebec Streams Commission, the complete storage scheme is estimated to cost nearly $3,500,000.

House Committee Considers Day Labor

On March 8 a sub-committee of the Committee on Judiciary of the House of Representatives had the first of a series of hearings in consideration of H. R. 8902, a bill introduced by Representative Campbell, of Pennsylvania, to regulate the extent of day labor construction by the United States Government. The bill provides that in all construction totaling more than $5,000 in value full preliminary designs and estimates shall be made and that the contracts shall be publicly advertised and let to the lowest bidder "capable of performing" the contract. The government officer is permitted to build not more than 10 per cent of his work by public forces, if for any reason he is not satisfied that the contract method is to the best interest of the government.

At the first day's hearing members of the Associated General Contractors of America presented briefs in favor of the bill. It was announced that on March 16, Maj.-Gen. Harry Taylor, Chief of Engineers, would be heard on the bill.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Annual Meeting, St. Petersburg, Fla., March 29-31, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16; Summer Meeting, Seattle, Wash., June 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 10-13, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Philadelphia, Pa., June 13-19, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

INTERNATIONAL CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The San Francisco Society of Engineers is the name chosen for a newly organized body, comprising a membership of 500 engineers representing all branches of the profession. The organization is devoted to the interests of professional engineers. The society maintains an employment bureau with offices at 952 Pacific Building. Regular meetings are held the second Tuesday evening, each month. C. H. Tucker is president, Glen B. Ashcroft, vice-president, and A. J. Capron, secretary.

Personal Notes

JULIUS ADLER, deputy chief of the bureau of highways in Philadelphia, Pa., resigned Feb. 15 to open an office in Philadelphia for the practice of consulting engineering in the highway and paving field. After a year in the United States Bureau of Public Roads and three years teaching civil engineering in the State University of Washington, Mr. Adler joined the Philadelphia highways bureau in 1912, in 1916 became engineer of tests for the Pennsylvania State Highway Department, in 1919 engineer for the asphalt department of the Atlantic Refining Co., and in 1920 deputy chief in the bureau of highways for Philadelphia city and county, in charge of contracts, specifications, construction and maintenance. CLARENCE E. MYERS, engineer of construction in the Philadelphia highways bureau, succeeds Mr. Adler as deputy chief of highways.

RALPH H. STEARNS, New York City, has severed his connection with Sanderson & Porter to accept a position as hydraulic engineer with the General Engineering & Management Corporation, New York City.

CLARENCE C. TEAFF, of Columbus, Ohio, has been appointed city engineer of Daytona Beach, Florida; in Ohio he had fifteen years' experience in municipal engineering and in county and state road work. A. E. PAGE, who had been acting in the capacity of city engineer at Daytona Beach, will continue in the department as assistant.

CHARLES H. PAUL, consulting engineer for the Miami Conservancy District, and a director of the American Society of Civil Engineers, has been elected a member of the city commission of Dayton, Ohio. Mr. Paul is the first engineer to hold membership on the city commission since its creation in 1914.

HARRY S. STARKEY has resigned as secretary of the Detroit Board of Water Commissioners, to take effect March 1, the forty-second anniversary of his appointment to the Water Department. For about 10 years prior to 1910, he was general manager of the department.

W. PARKER IRELAND, who was formerly hydraulic engineer for the Edgar A. Rossiter Co., Chicago, was recently appointed superintendent of hydro-electric construction work by the Utilities Power & Light Corporation of Chicago, and is now supervising the construction of a new hydro-electric plant on the Kickapoo River at Gays Mills, Wisconsin.

CHARLES M. REPPERT, Pittsburgh, Pa., who has been assistant director of the department of public works of Allegheny County. Pennsylvania, has been appointed chief engineer of the department of public works of the city of Pittsburgh; the position of chief engineer to the department was recently created by council action in Pittsburgh.

W. B. CAUSEY, for the past two years city manager of Norfolk, Va., has become associated with the M. E. White Co., the White Construction Co., and affiliated companies, as vice-president, with offices at 1735 Fullerton Ave., Chicago Ill. Prior to his work in Norfolk Colonel Causey served for six years in Europe, four years as technical adviser to the Austrian Republic, eight months as president of the Allied Railway Mission under a mandate from the Supreme War Council, reorganizing the transportation systems of central Europe, 1917-1918, and earlier for sixteen months in France with the 17th Engineers as captain, major and lieutenant-colonel.

Obituary

C. F. GETTINGS, county engineer of Worcestershire, England, who made an extended trip through the eastern parts of the United States and Canada in 1924 to study highway building and highway traffic, died at Worcester, Feb. 1. On his return to England in 1924 he reviewed his studies at a meeting of the Institute of Municipal Engineers and Surveys.

GEORGE T. SAMPSON, Medford, Mass., railroad civil engineer, died Feb. 25, aged 77 years. Before retirement, he was an authority on construction of railroad bridges and foundations, being especially known for his work on the construction of South Station, Boston. His first railroad connection was with the old New York & New England road; when it was taken over by the New York, New Haven & Hartford, Mr. Sampson was made engineer of the Midland Division. After retirement from railroad work, he interested himself in a study of municipal building laws.

ADDISON J. MCCUNE, who was state engineer of Colorado for ten years until his resignation and retirement in 1923, died March 2 at his home in Grand Junction, Colo., aged 77 years. Mr. McCune was a native of Ohio but went to Colorado in 1879 and after working on Union Pacific and Denver & Rio Grande railroad location and construction began engineering work on irrigation projects. He was twice appointed state engineer, in 1899 and in 1917; in this position and in his years of consulting practice Mr. McCune had an important influence on the design, construction and management of irrigation works in the state.

REAR ADMIRAL MORDECAI T. ENDICOTT, U. S. N., retired, died last week of pneumonia, at his home in Washington, D. C., aged 81 years. Admiral Endicott was born in Mays Landing, N. Y., and graduated in civil engineering from Rensselaer Polytechnic Institute in 1868. He practiced as a private civil engineer until his appointment to the civil engineering department of the navy in 1874. Following duty at various navy yards and as consulting engineer to the navy, he was appointed a member of the Nicaragua canal commission in 1895 and made a member of the United States navy armor board in 1897. In 1898 he was appointed chief of the bureau of yards and docks of the Navy Department, with the rank of commodore, later advanced to rear admiral. He served as a member of the Isthmian Canal Commission in 1905 and retired as a rear admiral in 1906 but continued in active duties until 1909. During the war he was recalled to active service. He was vice-president of the American Society of Civil Engineers in 1908 and president in 1911.

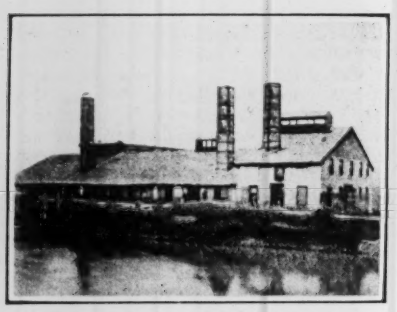
From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Iron and Steel Company Is 100 Years Old

Alan Wood Iron & Steel Co., Philadelphia, Pa., is celebrating its 100th anniversary this year, having been founded in 1826 when James Wood purchased an old rolling mill at Wooddale, Del., and formed the firm of James Wood & Son with Alan Wood. James Wood had started as a blacksmith in 1792 making also kitchen and domestic wares.

During its century of existence not only has the original business grown to large size, but blast furnaces,



OLD MILL, CONSHOHOCKEN, PA., BUILT 1832

coke ovens, and byproduct plants have been added to more efficiently control its manufacturing processes. Among the many products manufactured by the Alan Wood Iron & Steel Co. are the steel traffic treads used on many highway bridges and also for steel floor plates in such places as engine rooms, railway car vestibules, and on stairways.

Motor Makers Vote to Organize Rubber Company

Voting to form the American Motor Rubber Corp. with an initial capital of $10,000,000, the special committee on the rubber situation named by the directors of the National Automobile Chamber of Commerce, decided at a meeting recently on the following steps of immediate action: (1) To incorporate immediately, in the state of Delaware and to issue a call for stock subscriptions from 102 automobile companies. (2) To choose executive officers and select headquarters in New York. This was placed in the hands of a special committee. (3) To determine the comparative advantages of different sections of the world for rubber production.

Offers of rubber plantations and properties were presented to the meeting from Brazil, Ceylon, Old German East Africa, and Colombia, as well as a proposal for the development of a large tract in Cuba.

The new corporation's plans have to do with producing rubber, dealing in it as a commodity, and manufacturing automobile tires and other rubber products. There will be 10 directors, composed of automobile executives, three in addition to the following: John J. Raskob, vice-president, General Motors Corp.; C. W. Nash, president, Nash Motors Co.; A. J. Brosseau, president, Mack Trucks, Inc.; Roy D. Chapin, chairman, Hudson Motor Car Co.; Alvan Macauley, president, Packard Motor Car Co.; Arthur T. Waterfall, vice-president, Studebaker Corp.; and A. R. Erskine, president, Studebaker Corp.

Mileages by States of Concrete Pavement in United States

The concrete pavement contract awards in sq.yd. of road, street and alley paving as compiled monthly by the Portland Cement Association and published in *Engineering News-Record* have been reduced by the association into the equivalent mileage in each state. Roads are considered 18 ft., streets 30 ft., and alleys 18 ft. wide.

The accompanying table gives the mileage prior to 1925, the increment added during the year and the total mileage of each class of concrete pavement in each state as of Jan. 1, 1926.

COMPLETED MILEAGE OF CONCRETE PAVEMENT IN UNITED STATES
(Square Yards Reduced to Equivalent Mileages).

State	Roads (18 Ft. Wide) Prior to 1925	Roads During 1925	Roads Total to Jan. 1, 1926	Streets (30 Ft. Wide) Prior to 1925	Streets During 1925	Streets Total to Jan. 1, 1926	Alleys (18 Ft. Wide) Prior to 1925	Alleys During 1925	Alleys Total to Jan. 1, 1926
Alabama	48.3	70	118.3	100.2	48.6	148.8	10.1	7.9	18.0
Arizona	433.3	1	434.3	17.3	.....	17.3	1.1	2.2	3.3
Arkansas	202.1	28	230.1	131.0	21.5	152.5	2.3	1.7	4.0
California	3,465.9	161	3,626.9	1,012.3	316.0	1,328.3	65.1	19.7	84.8
Colorado	190.6	14	204.6	61.6	4.4	66.0	120.6	20.4	141.0
Connecticut	314.1	35	349.1	84.5	5.4	89.9	1	.....	1
Delaware	355.2	63	418.2	7.4	1.3	8.7	.....	.....	.....
Dist. of Columbia	8.0	1	9.0	40.7	15.5	56.2	23.4	5.7	29.1
Florida	163.7	66	229.7	49.5	27.6	77.1	4.3	.5	4.8
Georgia	363.8	65	428.8	272.0	52.1	324.1	2.4	.9	3.3
Idaho	38.3	10	48.3	18.0	.....	18.0	1.4	.....	1.4
Illinois	4,104.5	853	4,957.5	600.4	250.0	850.4	360.5	133.0	493.5
Indiana	1,535.2	337	1,872.2	240.9	58.0	298.9	70.1	17.5	87.6
Iowa	536.4	64	600.4	637.4	62.3	699.7	83.2	7.5	90.7
Kansas	484.7	32	516.7	148.4	27.8	176.2	33.1	5.5	38.6
Kentucky	150.9	82	232.9	62.1	20.8	82.9	26.4	8.7	35.1
Louisiana	29.4	7	36.4	38.8	16.4	55.2	7.1	5.5	12.6
Maine	65.8	3	68.8	15.5	3.0	18.5	.5	.1	.6
Maryland	966.2	120	1,086.2	44.9	12.7	57.6	116.5	7.2	123.7
Massachusetts	228.9	50	278.9	109.5	15.2	124.7	1.5	.3	1.8
Michigan	2,042.2	425	2,467.2	341.6	81.0	422.6	240.0	53.8	293.8
Minnesota	520.2	94	614.2	195.5	32.0	227.5	36.0	7.8	43.8
Mississippi	211.9	39	250.9	37.5	10.0	47.5	2.1	.2	2.3
Missouri	503.2	477	980.2	414.5	84.5	499.0	56.3	18.2	74.5
Montana	27.0	...	27.0	34.9	.....	34.9	6.8	.....	6.8
Nebraska	68.8	26	94.8	67.3	19.9	87.2	21.6	3.3	24.9
Nevada	31.4	7	38.4	4.9	3.1	8.0	.6	.1	.7
New Hampshire	11.9	6	17.9	10.2	.8	11.0	.3	.1	.4
New Jersey	689.9	113	802.9	297.1	91.4	388.5	2.6	.5	3.1
New Mexico	74.5	6	80.5	20.6	6.9	27.5	2.9	.....	2.9
New York	2,794.2	615	3,409.2	411.1	122.8	533.9	6.9	1.3	8.2
North Carolina	841.7	329	1,170.7	121.3	31.2	152.5	1.4	.5	1.9
North Dakota	7.4	...	7.4	27.2	2.2	29.4	3.1	.2	3.3
Ohio	1,646.2	210	1,856.2	257.0	53.7	310.7	54.9	13.7	68.6
Oklahoma	375.3	188	563.3	208.6	41.4	250.0	16.3	1.6	17.9
Oregon	227.4	25	252.4	156.4	42.7	199.1	7.9	1.5	9.4
Pennsylvania	2,707.2	724	3,431.2	190.5	83.8	274.3	41.4	10.6	52.0
Rhode Island	52.2	14	66.2	6.8	1.8	8.6	.05	....	.05
South Carolina	153.2	56	209.2	39.2	5.8	45.0	.4	.1	.5
South Dakota	1.4	...	1.4	99.8	5.8	105.6	5.9	.....	5.9
Tennessee	129.6	75	204.6	71.4	21.0	92.4	5.9	5.5	11.4
Texas	489.3	71	560.3	214.0	33.4	247.4	16.5	4.2	20.7
Utah	239.1	2	241.1	41.9	2.4	44.3	2.8	.1	2.9
Vermont	19.8	5	24.8	18.5	2.2	20.7	.15	....	.15
Virginia	614.9	91	705.9	68.7	9.4	78.1	2.4	.5	2.9
Washington	1,029.7	81	1,110.7	347.7	96.4	444.1	24.3	7.1	31.4
West Virginia	569.2	68	637.2	70.0	13.5	83.5	10.8	1.7	12.5
Wisconsin	1,921.2	152	2,073.2	464.7	84.6	549.3	118.2	21.3	139.5
Wyoming	13.0	...	13.0	20.9	3.5	24.4	.9	.....	.9
Total	31,698.3	5,961	37,659.3	7,952.2	1,945.9	9,898.1	1,619.1	398.2	2,017.3

Increase in Imports of Cement and Brick From Belgium

According to consular advices to the Department of Commerce, the outstanding feature of Belgium's 1925 export trade with the United States was the greatly increased volume of bricks and cement shipped. Exports of cement in 1924 were valued at $938,483 while the 1925 value was $3,246,01). The value of brick exports in 1924 was $209,831 and increased in 1925 to $570,049.

Conference Adds One More Size of Hollow Building Tile

After having been in effect nearly two years, the simplified practice recommendations as to hollow building tile which reduced 39 sizes to 19 have been revised by the addition of one new size tile 8x8x8 in. with the nine-cell construction. This size was found to be growing in demand as shown by a survey made from figures supplied by 143 of the 201 companies in the United States making the product. The survey showed that less than 10 per cent of the output for the first half of 1925 was in sizes not included in the simplified list. The revision was

adopted at a meeting recently in Chicago, presided over by H. R. Colwell of the Division of Simplified Practice, U. S. Department of Commerce.

Business Notes

NATIONAL ELECTRIC MFG. CO., Pittsburgh, Pa., has changed its name to Syntron Co.

W. C. HANLEY, New Orleans, is handling the representation of the building equipment department of the Duriron Co., Inc., Dayton, Ohio, in the states of Louisiana, Alabama and Mississippi.

READING IRON CO., Reading, Pa., announces the appointment of R. M. Thomas and Donald Charlton as technical representatives of the company, giving their time to its railroad business.

LOS ANGELES PRESSED BRICK CO. and Gladding, McBean & Co., San Francisco, whose combined assets total more than $8,000,000, have recently consolidated. The manufacture of bricks by the several plants of both companies will be carried on under Atholl McBean.

H. C. OSMAN, sales manager, Nugent Steel Castings Co., Chicago, has been elected secretary of the company. He will continue to have charge of the sales. C. A. MacDonald, formerly secretary, has been elected treasurer.

HARRY D. BEATON has been appointed eastern manager of the National Steel Fabric Co., Pittsburgh, Pa. His headquarters will be in the Liggett Building, New York City

CLIMAX ENGINEERING CO., Clinton, Iowa, announces the appointment of Rapp-Huckins Co, Inc, Boston, as its district representative.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., announces that its business in continental Europe will be handled through an organization recently incorporated as Allis-Chalmers (France) with headquarters at 3 Rue Taitbout, Paris. H. I. Keen, who has been manager of European sales, will be the managing director of the new organization.

GENERAL ELECTRIC CO., Schenectady, N. Y., announces that orders received for the year ending Dec. 31, 1925, amounted to $302,513,380. This is compared with $283,107,697 for the year 1924, an increase of 7 per cent. For the three months ending Dec. 31, 1925, orders totaled $78,636,669, compared with $80,009,978 for the same quarter of 1924, a decrease of 2 per cent.

TOCH BROTHERS, INC., paint manufacturer, has changed ownership through the purchase of all of the capital stock of the company by the Standard Varnish Works, New York City. Toch Brothers, Inc., has been continuously under the management of one family since its foundation in 1848, and will so continue in the hands of the sons of the founder. The amalgamation will permit of the rapid expansion of Toch Brothers, Inc., through the additional facilities afforded by the large plants of the Standard Varnish Works.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, 350 Madison Ave., New York City, announces its incorporation under the laws of the state of New York as of Jan. 6, 1926.

WESTERN PIPE & STEEL CO., San Francisco, Calif, has made arrangements with the East Jersey Pipe Co., New York City, to manufacture lock-bar pipe for the Western market The East Jersey Pipe Co. has controlled the manufacturing rights of lock-bar pipe in this country for the past 21 years, and the arrangement recently made with Western Pipe & Steel is intended to give buyers of lock-bar pipe in the west the service and advantages that accompany local manufacture

ORTON & STEINBRENNER CO., Chicago, Ill., announces a change in its corporate name to Orton Crane & Shovel Co. No change in personnel is involved, the reason for the change in name being to describe better the company's principal activities.

DAYTON WHIRLEY CO., Dayton, Ohio, announces a reorganization of the company which includes a combination with the I. R. Bailey Equipment & Repair Co., which was organized originally to take over the shops of the Miami Conservancy District at Dayton and act as selling agent for about one-third the plant of the conservancy district. The new company will continue the repair business of the Bailey Equipment Co. as well as manufacturing a full revolving dragline machine. The repair shop has every facility available for thoroughly rebuilding and overhauling any kind of construction machinery and contains 20,000 sq.ft. under roof.

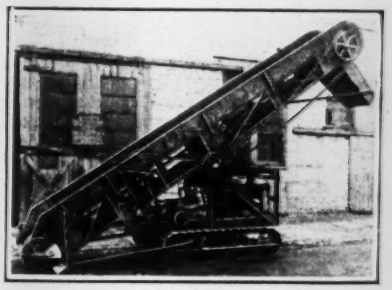
LINK-BELT CO., Chicago, has created a new position in its organization—that of chief engineer of the company. W. W. Sayers, formerly chief engineer of the Philadelphia plant, has been selected to fill the new position. Mr. Sayers graduated from the University of Illinois in 1897, and in his 23 years of experience with the Link-Belt Co., has held many important positions in the engineering, construction and sales departments of the company. His new position carries with it the responsibility of general supervision over all engineering work in the several plants of the company and following up new engineering development.

AMERICAN HOIST & DERRICK CO., St. Paul, has recently opened a branch office in the Railway Exchange building, St. Louis, Mo., with Ward B. Maurer in charge. Mr. Maurer has been with the company for several years, prior to which he was a member of the engineering staff of the Baltimore & Ohio R.R.

Equipment and Materials

Distinctive Features on New Snow Loader

The new snow loader of the George Haiss Mfg. Co., Inc., New York City, recently used in the city of Chicago, embodies an adjustable snow boom, moving angle cleats for elevating the snow on the boom, and a snow clean-up scraper. The snow boom is 42 in. between side boards and is in reality a steel trough up which the snow is



carried by the angle cleats which are 3 ft. long and fastened to an endless chain. The machine is mounted on caterpillar treads 8 ft. long and 10 in. wide, using a Fordson tractor as motive power.

The boom is equipped with patented raising and lowering device and is so balanced that one man can easily raise and lower it. The loader has a capacity of 5 cu.ft. per minute. The feeding end is equipped with patented feeding propellers somewhat shorter in design than those used on elevating truck loaders. These propellers break up ice as well as snow and push it toward the center where the angle cleats pick it up. There are three speeds reverse into the pile of 18, 38, and 84 ft. per minute respectively, and one speed of 32 ft. per minute forward. The machine weighs 14,000 lb.

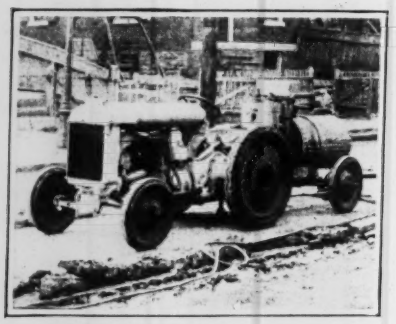
Huge Crawler Unit Used on 500-Ton Dragline

There has recently been built by the Bucyrus Co., South Milwaukee, Wis., and placed in operation in the construction field, a caterpillar mounting for the large dragline of the 320 class manufactured by the company. This mounting is also available for the 320-B

shovel. It is composed of four units, one under each corner of the base. Each of these units is made up of two caterpillar belts 36 in. wide and approximately 5 ft. high over the rollers. There are two of these rollers, an idler tumbler and a driving tumbler. In spite of the weight of the machine, 500 tons, the bearing area of the caterpillar belts is said to be such that it can propel itself across soft, yielding ground without difficulty.

Improvements Made on Trailer Type Compressors

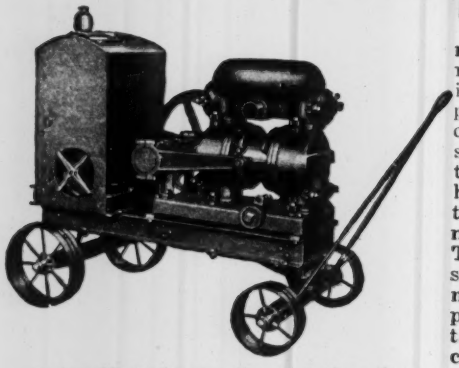
The portable air compressor built by the Curtis Pneumatic Machinery Co., St. Louis, Mo., for use as a trailer unit to a Fordson tractor has been improved in several particulars. Built-in jack legs provide a steady support against vibration during operation. The wheel-mounted type as illustrated uses either steel or rubber-tired wheels. Connec-



tion to the tractor is by hooks attaching over the rear axle. Power transmission from the Fordson engine to the compressor is by a belt. The compressor is equipped with its own thermo-siphon circulating system and automatic splash lubrication with sight feed to the cylinders. Another feature differing from the older models is that the tank is now mounted horizontally on the compressor frame instead of vertical. The machine is built only in a 100-cu.ft. size.

Trench Pump Combines Both Suction and Force Action

A new trench pump manufactured by the Humphryes Mfg. Co., Mansfield, Ohio, is claimed to be capable of lifting



water 25 ft. by suction and then forcing it to an additional height of 50 ft. The pump, equipped with either diaphragms or plungers, is suited for a variety of uses, such as bridge footings, trenches, cofferdams, caisson work, building foundations, and similar work. The pump is compact, of sturdy construction, and has large direct waterways, ball valves resting on machined valve seats, and is powered with a Le Roi gasoline engine. The entire equipment is mounted on steel frames and trucks. An air chamber which has been incorporated in the discharge manifold is claimed to even the load on the pump and the hose.

The field of usefulness of a lift and force pump is practically double that of the open diaphragm pump. By disconnecting the discharge line, the pump is suitable for open-diaphragm work. When fitted with plungers which are always outside packed the pumps are suitable for irrigation, fire protection, and jetting work. Suction and discharge connections are located on both sides of the pump. The valves can be removed and the pump cleaned by merely removing the port caps. A one-piece steel casting forms the eccentric disk and shaft.

When equipped with diaphragms the pumps are suitable for pumping water containing large amounts of impurities and when equipped with plungers are suitable for higher pressures although they will not pass so much grit.

Cast-Iron Culvert Pipe Has Spiral Corrugations

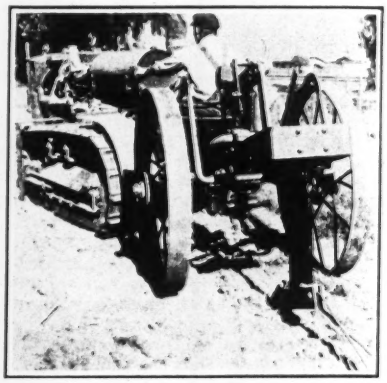
After several years of experimenting and trial, the American Casting Co., Birmingham, Ala., has produced a spiral corrugated cast-iron culvert pipe which it is claimed satisfies several requisites that originally were laid down as necessary in the design and

manufacture of such a pipe. These requisites were: (1) Pipe must be light in weight to permit low first cost; (2) pipe must be 20 to 40 per cent in excess of highway specifications for crushing strength; (3) pipe must be manufactured in short lengths to permit easy handling; (4) pipe must be of a continuous tube construction without the necessity of making joints in the field. The corrugations in the pipe add strength to it, at the same time permitting thinner walls which in turn permit a lower first cost. The continuous tube construction is obtained by casting the corrugations spirally. One piece of pipe screws into the other, one complete turn taking up 3 in. Since the pipe is made in lengths 3 ft. 3 in. long, each section lays 3 ft. net. By casting the pipe vertically in green sand and literally screwing it out of the mold it is possible to obtain not only thin but uniform pipe.

The pipe consists of two members, the pipe member and the cuff member. The pipe member screws into the cuff member, which is oversize while the internal diameter of the pipe member is cast to size. The pipe is available in diameters of 18, 24, 30 and 36 in.

Burying Light Cable Without Use of a Trench

A device for the laying of light cable without the expense of trench digging and filling has been perfected by the Killefer Mfg. Co., Los Angeles, Calif.



The illustration shows the equipment raised out of the ground. It is possible to bury a cable as deep as 24 in., the length pulled being determined by the tensile strength of the cable itself.

Publications from the Construction Industry

Conduit Systems — MURRAY CONDUIT SYSTEMS, New York City, has ready for distribution a booklet describing the use of Murray conduit-forming apparatus used in constructing monolithic concrete conduits. The booklet is divided into four main parts treating the following subjects in a technical and practical manner: Underground electrical conduits; conduits in industrial building; conduits in tunnels and subways; and underground accessories.

Pumps—PELTON WATER WHEEL CO., San Francisco, has published a new bulletin describing its types DS and ST pumps which are in general applicable in industrial service or in municipal water supply where large capacities or high pressures are to be handled.

Cement—ALPHA PORTLAND CEMENT CO., Chicago, Ill., has ready for distribution a new 112-p. handbook, entitled "Alpha Cement—How to Use It." The bulletin contains much practical information on all construction work in which cement is used. Illustrations, drawings and diagrams add to the usefulness of the text.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

High Spots in the New Revenue Law

Probabilities Are That Act of 1926 Will Prove to Be Last of All the Great Post-War Tax Reduction Measures

By Robert Murray Haig
School of Business, Columbia University

THE Treasury estimates that the Federal Revenue Act of 1926, signed by the President during the last week in February, will yield $2,365,189,000 during the calendar year 1926, which is $387,811,000 less than the old law would have produced. In 1927 the loss is expected to be less, only $343,000,000. These reductions are so substantial that concern is expressed regarding the adequacy of the yield to meet the government expenses. However, the Treasury estimates in recent years have been so conservative that the leaders in Congress are inclined to take with a grain of salt any gloomy forebodings emanating from the other end of Pennsylvania Avenue. Indeed some are already suggesting that there are hidden reserves in the estimates which will make possible a pre-election tax-reduction in 1928. Much depends, of course, upon the degree of business prosperity experienced during the next few years as well as upon the degree of self-restraint exhibited by Congress in its appropriations. All in all, it seems probable that the Act of 1926 will prove to be the last of all the great post-war tax reduction measures. Business should plan to adjust itself to a long-time burden of approximately the present proportions.

Opinions as to the wisdom of the present slash in taxation vary widely. Many expect it to have a highly beneficial effect upon the business situation. The newspapers quote a banker as stating that the new law means $387,811,000 additional capital available for investment. Of course, no one can discuss such a point intelligently without making assumptions regarding the purpose for which the money would have been spent, had the reduction not been made. If it were spent for new battleships, the effect would be different from what it would be if it were spent for roads and schools. If it were spent for redemption of Liberty Bonds, the amount of capital available for investment might be no greater or no less than it will be with the Revenue Act of 1926 in effect.

General Features of the New Law

More than half of the reduction in the new law is made in the miscellaneous internal revenue taxes. The net reduction in the income taxes is only $164,400,000. The capital stock tax is abolished at a loss of $68,500,000 this year. The estate tax is cut $15,000,000 and the gift tax repealed at a cost of $2,000,000. Taxes on automobiles, trucks, tires, etc. are reduced $82,150,000. Cigar taxes drop $17,000,000. No less than fifteen "nuisance" taxes are entirely swept away reducing the list of the miscellaneous internal revenue taxes practically to pre-war proportions.

The struggle between the House and the Senate centered about the question of the retention of the federal estate tax. The final decision was in favor of retention but at reduced rates (20 per cent maximum with an increased exemption, $100,000) and with an increased credit for state taxes (80 per cent).

Although the net reduction in the income tax as a whole is only $164,400,000 the cut in the personal income tax alone is no less than $214,075,000 distributed as follows:

Increase in personal exemptions	$42,000,000
Reduction in the normal rates.	46,000,000
Reduction in surtax rates.....	119,075,000
Increase in the earned income credit	7,000,000
Total	$214,075,000

This large decrease in the personal income tax is accompanied by an increase in the corporation income tax. The 12½ per cent rate has been raised to 13 per cent for the year 1925 and to 13½ per cent thereafter to compensate for the loss of revenue due to the abolition of the capital stock tax. This latter tax has been the cause of great complaint. Assessed as it was on the basis of a valuation of the stock, it involved much administrative difficulty and the corporations generally will applaud the change even though it means no reduction in their aggregate taxes.

Changes in the Income Tax

The details of the changes of most general interest, such as the reductions in normal rates to 1½, 3 and 5 per cent, the reduction in the surtaxes to a maximum of 20 per cent, the increase in the earned income credit by permitting $20,000 to be considered earned, and the increase in the personal exemptions to $1,500 and $3,500, have been adequately reported in newspaper accounts and are set forth in the income tax blanks with which the reader will be struggling when this article appears. The higher personal exemptions mean that 2,300,000 fewer people will have to struggle this year than last. It may be noted in passing that the increased credit for earned income is a more substantial concession than appears on the surface. Under the old law a man with $20,000 earned income could at the most secure a reduction of $90. Under the new law such a person might secure a reduction of $250.

Aside from these changes, the modifications in the income tax are not numerous and those which merit comment in a general article are very few indeed. The publicity of tax payments is abolished, the Board of Tax Appeals is strengthened and a joint committee of five senators and five representatives is established to make a study of the revenue system in general. Depreciation actually sustained before March 1, 1913, must be deducted in arriving at the basis from which to measure gain when property was acquired before that date at a cost greater than the value on that date.

The Exemption of Foreign Traders

A new provision of the law and one which is being widely heralded in the newspapers as being wise and just is that which permits an individual citizen of the United States who resides abroad for more than six months of the year, to ignore entirely in making up his return "amounts received from sources without the United States, if such amounts constitute earned income * * *." The case for this amendment rests upon the alleged practice of other countries in refraining from taxing such income. As the situation now stands, however, if the foreign country in which the American trader is residing six months taxes him at a less rate than the federal rate, he is placed in an advantageous position as compared with the American trader at home. Again, even though the foreign country has tax rates as heavy as our own, the trader who is taxed on half of his income abroad and on half of it here, falls in the lower brackets in both countries. This, then, appears to be a subsidy to foreign trade at the expense of domestic trade which is far from wise and just.

Retroactive Validation of Treasury Interpretation

Near the very end of the law, among the administrative provisions, appear two innocent looking sections (1207 and 1208) which were inserted at the last moment on the floor of the Senate. In spite of their innocuous appearance, it is not unlikely that these provisions may prove to have far-reaching consequences of a very undesirable character. They are designed, in the case of installment sales and in the case of invested capital computations, to legalize retroactively the Treasury interpretation of the law as far back as 1916.

It has been the theory of the federal tax administration that the Treasury shall construe the law strictly in favor of the government and that the tax-

(Continued on p. 430)

Weekly Construction Market

FIRMNESS in the price of brick and scarcity of this material is apparent in New York, while quotations are down 50c. per M. this week in the San Francisco market. Pine lumber continues to retain its strong price position accompanied by a noticeable stiffening in Douglas fir on the West coast.

The present declining trend in linseed oil is nation-wide in scope. Compared with the Feb. 25 level, the current price is down 1c. in Atlanta, 3c. in Chicago, 4½c. in New York, 5½c. in Minneapolis and 8c. per gal. in Denver. At this time last year prices were advancing in the West.

Throughout the Northeastern states there is appreciable firmness in cement, tile, white lead and glass, with slight weakening of quotations on Douglas fir two-by-fours, roofing materials and c.-i. pipe.

Negotiations between the thirty-seven New York building trades organizations and the employers have, thus far, resulted in a settlement with regard to wages of most of the key trades. Final decision is pending, however, on schedules for helpers and the remainder of the skilled mechanics.

The majority of the skilled men received an advance of $1.50 per day, making the base rate $12, retroactive to March 1, 1926.

Settlement was also assured with the New York stone setters for an advance of $2, making the base rate in this trade $14 per day; agreements will probably be reached with the bricklayers and plasterers at the $14 rate. A small group of stonemasons working on the Cathedral of St. John the Divine are still on strike for $16, against the 1925 rate of $12 per day.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	3.10	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	53%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	—45.25	54.00	—49.20@50.20	53.00	64.00	+52.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.70	+2.35	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	2.00@2.20	1.65	1.90	1.80	1.50	1.25
Sand, cu.yd	1.00	+1.60	2.00	2.25	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	2.00@2.20	1.75	2.50	1.70	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	63.00	34.00	56.00	57.50	37.75	—34.75	27.00	25.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	21.00	10.50	11.10	12.00	13.50	12.00	—15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	.10	.075	.....	.075	.....	.10	12
Hollow partition tile 4x12x12, per block	.1112	.0977	.10	.075	.07	.075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	—.83¼	—.90¾	1.13	—.85	—.94½	—1.06	1.02	1.12	1.12
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 4, the next on April 1.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.50). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

High Spots in New Revenue Law

(*Concluded from p. 429*)

payer, if dissatisfied, shall seek redress in the courts. In the cases in point, decisions have recently been handed down by the Board of Tax Appeals and by the courts which hold the old treasury interpretation invalid. The amendments validate them retroactively. In effect, they give notice to taxpayers who disagree with the interpretations of the Treasury, that the Treasury will ultimately be declared to be right even though the courts say it is wrong and that even though the courts grant relief the relief shall not be given. How any one would have the courage to contest a Treasury ruling under such circumstances is difficult to understand.